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NOVEMBER, 1929

CIRCULATION THIS ISSUE
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UTAH'S FAMOUS MINE IN BINGHAM CANYON FROM WHICH HAS BEEN OBTAINED MORE THAN THREE BILLION POUNDS OF NEEDED COPPER.

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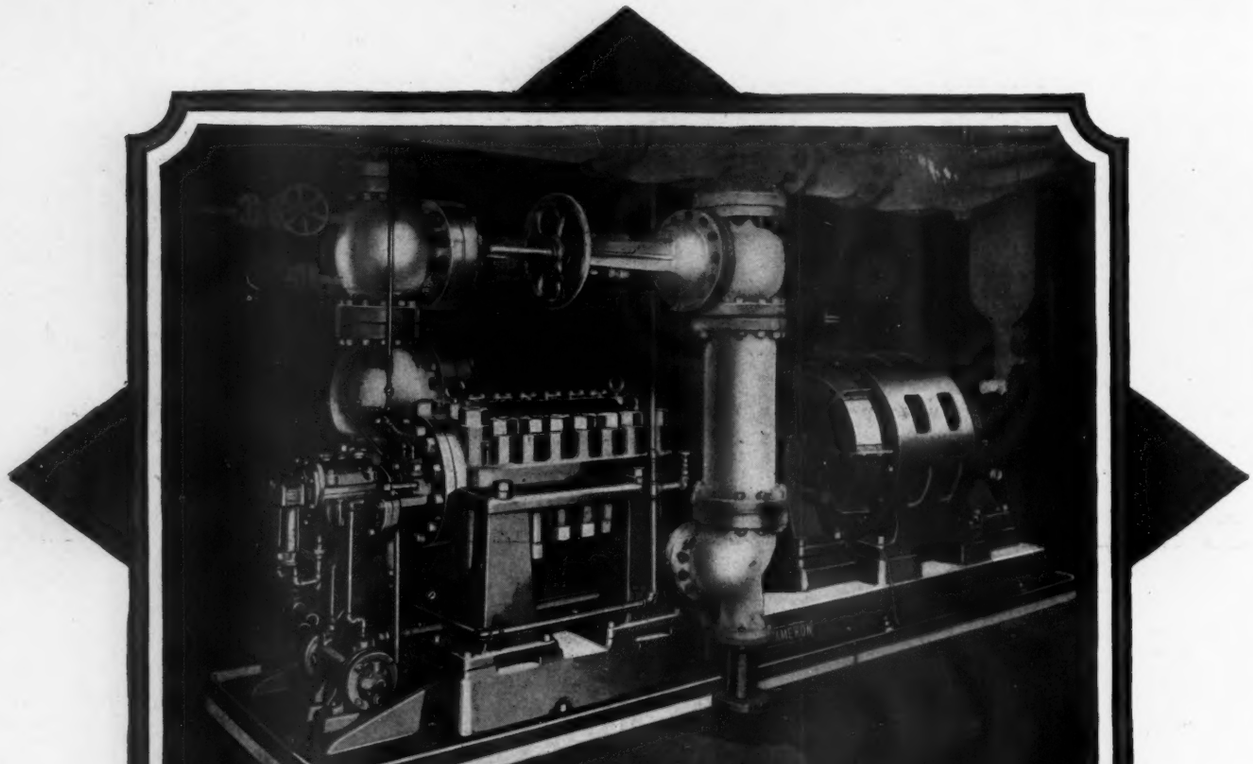

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VOL. XXXIV, NO. XI

NOVEMBER, 1929

Bingham Canyon's Great Copper Camp

Utah Copper Company Is Known the World Over Because of What It Has Done at Bingham on a Vast Scale

PART I

By R. G. SKERRETT

MARS, when closest to us, is 35,000,000 miles away in boundless space. Incomprehensively magnificent as this distance is, still we could bridge that stupendous gap telephonically if all the copper produced by the Utah Copper Company in the course of its 26 years of activity were turned into wire and hung between Mars and the earth. Indeed, enough copper has been produced by that company to form a wire 74,000,000 miles long and as thick as the lead of a pencil—sufficient to span twice the distance between the two planets and yet leave an excess of 4,000,000 miles for switchboard and distributing service!

Let us bring the meaning of this output nearer home. If the more than 3,000,000,000 pounds of copper that has been mined by the Utah Copper Company at Bingham Canyon could be drawn into a single wire the size of a lead pencil it would be ample to encircle the equator 92 times! The significance of these figures stands out still more when we are reminded that all this red metal has been obtained from ore carrying an average of a little more than 1 per cent of copper per ton of ore mined. Furthermore, in addition to each ton of ore sent to the mills a ton of waste rock has to be mined—in other words, 2 tons of rock must be drilled, blasted, shoveled, and transported in order to secure about 20 pounds of marketable copper. That all this work can be done and a substantial profit realized is outstanding evidence of the skill and the resourcefulness of the men that have made this splendid accomplishment possible. We shall tell more about this monumental work presently. In the meanwhile, we shall sketch briefly how Bingham Canyon became the center of a spectacular mining undertaking, and developed into a vast copper camp despite the fact that the earlier owners expected to exploit the property as a source of gold.

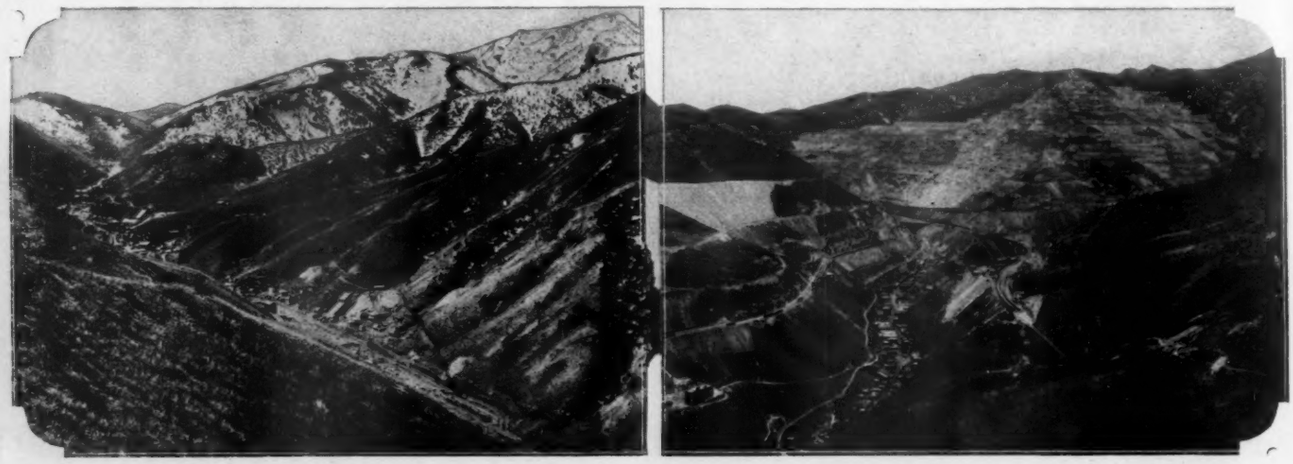
UTAH'S mountain of copper ore at Bingham, in the heart of the Oquirrh Range, is today providing the world with 8 per cent of the red metal required for a multiplicity of modern services. Strange as it may seem to us at the present time, this vast source of an indispensable metal was long looked upon with indifference by men seeking an outlet for their capital in mining enterprises.

Last year, the Utah Copper Company obtained from its mine at Bingham sufficient ore to yield a total of 273,823,351 pounds of refined copper! This is the current climax to years of skillful operation and farseeing management. It is a record of accomplishment that warrants both admiration and wonderment when the facts in the case are known. Of its kind, this great mine at Bingham stands forth preeminent for many reasons.

The accompanying story is a revelation of what engineering cunning can achieve in the face of numerous difficulties of outstanding magnitude.

Bingham Canyon is in the Oquirrh Mountains, about 35 miles to the south and west of Salt Lake City. Accounts differ as to just how the mineral wealth of the canyon was discovered, but there is fairly general agreement that United States soldiers from Fort Douglas, overlooking Salt Lake City, prospected the canyon in 1862. Their commanding officer, Gen. Patrick E. Connor, encouraged them to explore the adjacent mountains, and he readily granted them furloughs for that purpose when they were not busy holding the Piutes and other Indians in check. Lead ore was found in the canyon in 1863—the ore also carrying promising percentages of silver; and some time during the same year veins of copper ore were discovered. But copper was not considered seriously by the mining fraternity of the early days in Bingham Canyon—most of the pioneer efforts being devoted to getting out lead, silver, and gold. Indeed, it was not until near the end of 1896 that any large shipments of copper ore were made; and at that time 5,000 tons of sulphide ore were moved by rail from the Highland Boy Mine.

Strange as it may seem, the Highland Boy was started by Samuel Newhouse as a gold-mining project; and a cyanide mill was built to extract the gold from the oxidized ore. The mill was operated for some months, but was shut down because of the excessive amount of cyanide that had to be used to separate the gold from the copper—Newhouse and his associates having failed in their preliminary extraction work to take into account the large copper content of the ore. Just when the outlook was darkest for a profitable working of the property for gold, ore containing 15 per cent copper was struck in the lower adit of the Highland Boy. That find changed the whole situation, and Newhouse was able to obtain much needed funds. Copper, which previously had received little if any consideration by the miners in the



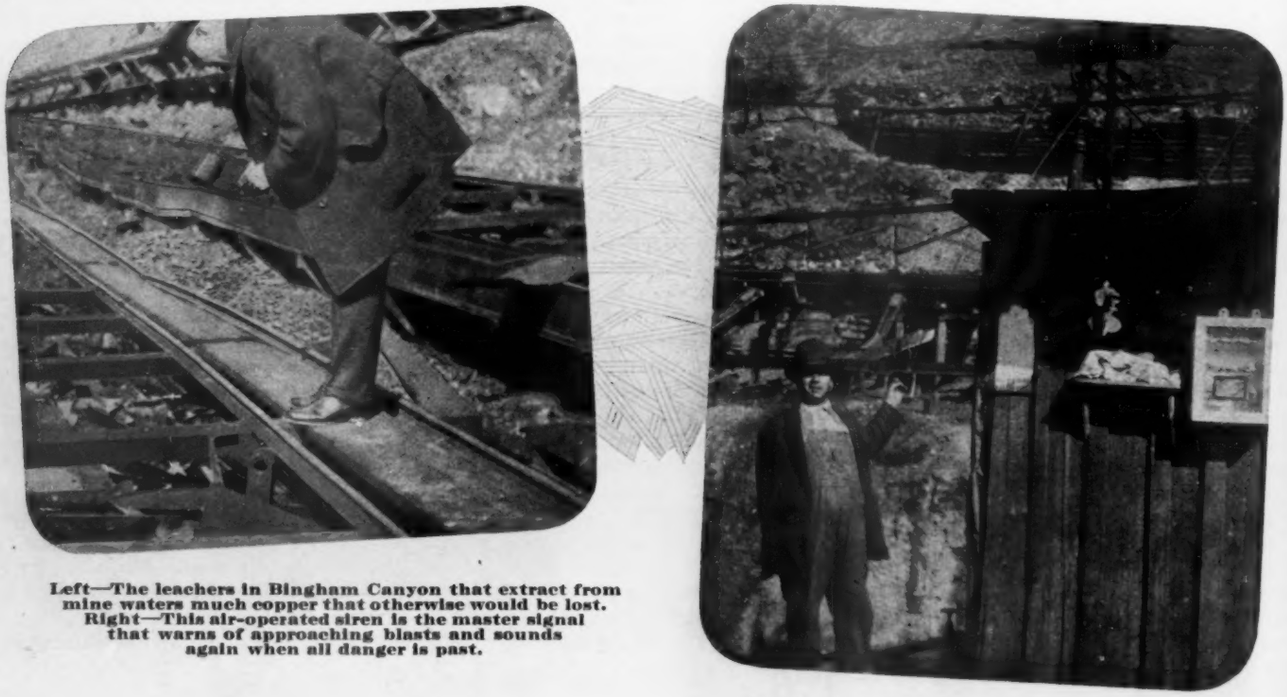
Left—Upper Bingham Canyon as it appeared in 1904. Right—The terraced hillside in the middle distance shows how the mountain of copper has been mined since the property has been in the hands of the Utah Copper Company.

canyon, suddenly acquired a new significance when the large shipment was made from the Highland Boy. Our story is getting measurably closer to the organization of the Utah Copper Company, whose activities have brought to Bingham its world-wide fame. But let us go back a bit to the latter "eighties", and to the quiet operations of a man of outstanding vision. We refer to Col. Enos A. Wall, whose military title was a friendly brevet.

Colonel Wall was an Indianian by birth, but as a youngster he moved into the West and cast his lot in regions largely devoted to mining enterprises. In time, he became a miner and a dealer in mines, and his shrewd judgment brought him substantial monetary rewards. With this background of ripe experience, Colonel Wall visited Bingham in the summer of 1887. His alert eye was soon arrested by a greenish discoloration on a hillside—the staining being vivid enough to be seen plainly from the road. That discoloration, he learned, was due to copper in solution that was carried over the bare rock by water issuing from a spring higher up. An examination disclosed to him an outcrop of monzonite which, when assayed, was found sufficiently impregnated with copper to contain 3 per cent, and such was the condition for a length of several hundred feet. Wall then entered an abandoned tunnel extending less than 100 feet into the hillside, and there obtained samples of copper-bearing rock that proved to carry 2.4 per cent of copper.

Wall kept his discoveries to himself, but he was tremendously impressed nevertheless. He learned at the Recorder's Office that a goodly part of the ground adjoining and surrounding that old tunnel had been abandoned for some time and was, therefore, available for relocation. Accordingly, he staked a couple of claims, and these gave him an area of 3,000 x 600 feet. Later on he located a third nearby claim. Unobtrusively, he kept on exploring the neighboring territory, where abandoned workings told their mute story of past failures—failures to produce the metals sought at the time but indicating notwithstanding widespread distribution of copper.

All those signs merely increased his interest in the towering hill lying between the V formed by Bingham Canyon on one side and Carr Fork on the other. Step by step, he added to his claims, but he was silent about his hopes because he had not money enough to start the necessary systematic development of his property. With funds obtained from other contemporary mining ventures, he acquired control over substantially 200 acres, and did the assessment work prescribed by law—spending incidentally quite $20,000 in driving more than 3,000 feet of tunnels, drifts, etc. Such was his position in 1896 when the Highland Boy made its copper shipment that promptly created



Left—The leachers in Bingham Canyon that extract from mine waters much copper that otherwise would be lost. Right—This air-operated siren is the master signal that warns of approaching blasts and sounds again when all danger is past.

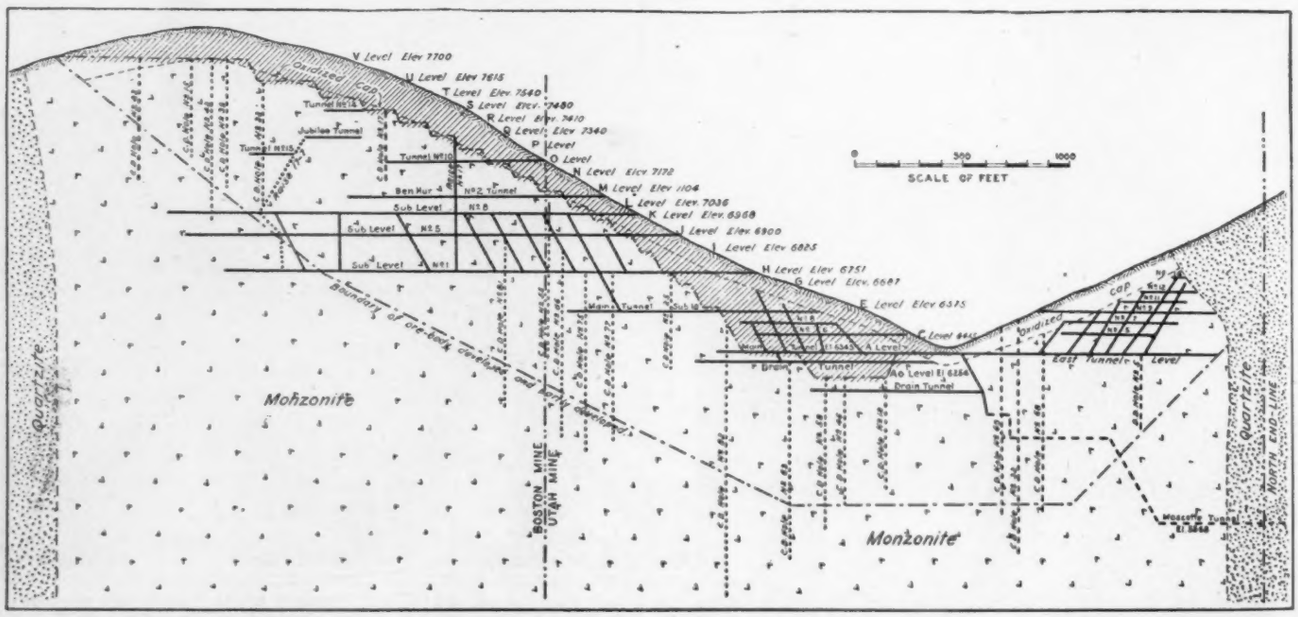
1—Looking down into the canyon toward the town which lies below the hill on the right. Picture taken before the adoption of electric locomotives. 2—This picture is a close-up of the working face of the mountainside. 4—The viaduct over Markham Gulch across which the ore trains move from the mine to the distant mills and smelter. 5—An expansive view of the leachers that garner copper from the waters issuing from underground workings. 3—Looking down into the pit that lies at the base of the mine to the distant mills and smelter.

Robert C. Gemmell, who played an outstanding part in the inception and the development of the Utah Copper Company.

Daniel C. Jackling, president of the Utah Copper Company, who devised the mining method practiced at Bingham.

something of a furor in mining circles. In short, Colonel Wall was right in on the ground floor. His faith in the "copper-bearing porphyry" at Bingham was confirmed by the output of the Highland Boy, and he was seemingly in a position to profit by his years of waiting. But things were not to be as he wished—years of delay were to follow because he had not the money to work his property on a proper scale, nor had his claims been sufficiently developed to attract others that could provide the large funds that would be needed for the work. To this end a promotor with ample backing was the immediate prerequisite. The man that fulfilled this *role* was Capt. Joseph R. De Lamar, a truly picturesque character and a person long familiar with mining properties in many parts of the country.

The recital of all that followed between Colonel Wall and Captain De Lamar would fill pages, but we shall have to confine ourselves here to the barest statement of certain outstanding facts. Captain De Lamar's interest in Wall's property began in 1895, when the Captain obtained a six months' option on three-quarters of it. During that period he made certain tests in a nearby stamp mill, and they showed that a concentrate averaging about 30 per cent could be produced from ore assaying 2 per cent copper. The state of the copper market about that time dissuaded the Captain from taking up his option. When the copper market improved in 1898, he resumed negotiations with Colonel Wall, and once more got an option on a quarter interest; and on the strength of that the Captain had certain additional tests made in a convenient stamp mill by Daniel C. Jackling. The results were very encouraging. De Lamar, however, wanted more time for exploratory work. Wearying of delay, Wall



Cross section of the property owned and operated by the Utah Copper Company in Bingham Canyon, showing the oxidized cap and the ore-bearing body now being worked.

refused an extension; but he offered to sell three-quarters of his property for $750,000 in cash. Then and there matters ended.

In 1899 De Lamar purchased a quarter interest for $50,000 cash, obtaining at the same time a year's option on another quarter interest. During that twelvemonth De Lamar spent $25,000 in extending drifts and in driving new crosscuts. The sampling was carefully supervised by Robert C. Gemmell, while the mill tests were looked after by young Jackling who had repaired an old mill in the gulch for the purpose. Even though the skillfully coördinated work of these two men produced a report of notable accuracy and of great technical and economic significance, and despite the fact that he had spent a good many thousands of dollars in exploring and testing, still Captain De Lamar allowed his option to lapse. However, he retained the quarter interest that he had purchased, and continued so to do until 1903, when he sold out to the Utah Copper Company which was organized that year under the laws of Colorado with a capitalization of $500,000. The change thus brought about in Colonel Wall's fortune might then have been delayed for years but for the initiative and the convincing efforts of Mr. Jackling, who had left De Lamar's service shortly after the conclusion of the tests at Bingham in 1899. Jackling had unbounded faith in what Bingham promised as a source of copper.

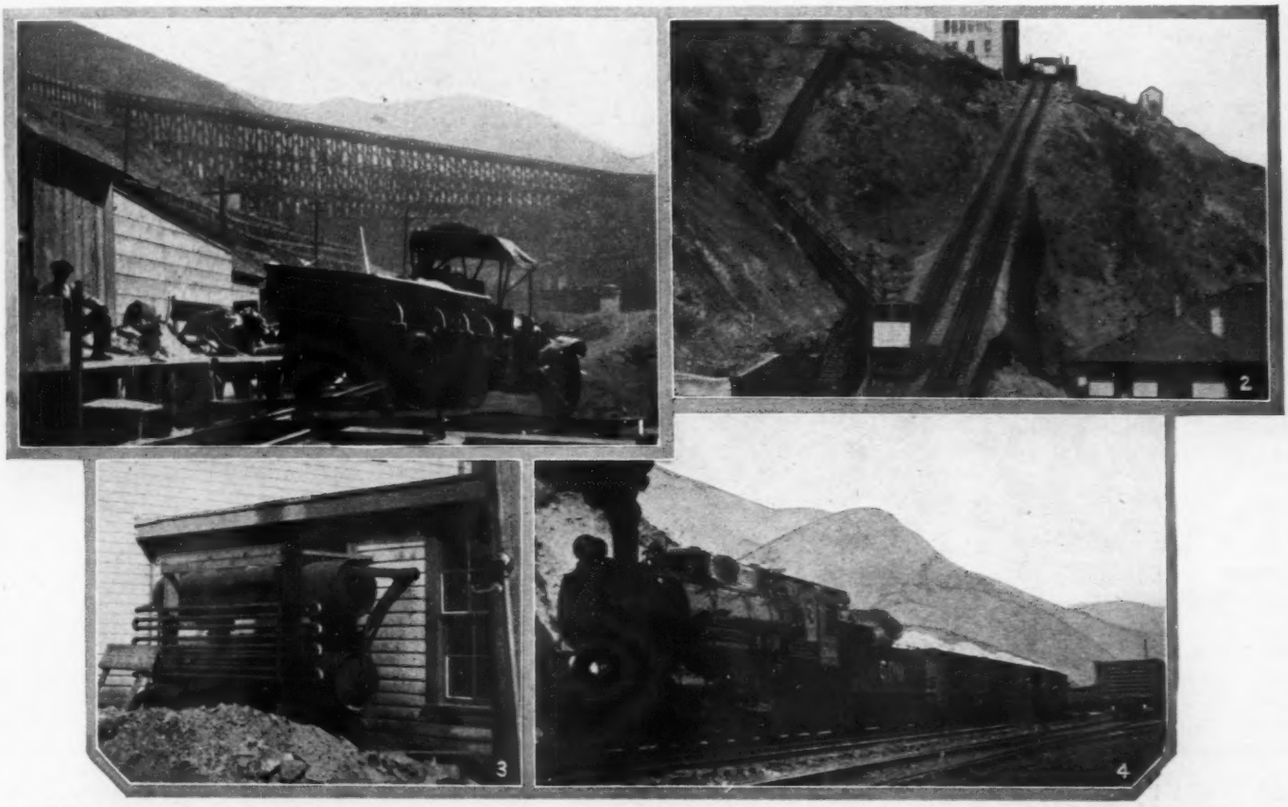
It may surprise many persons now that the Wall holdings went begging for monetary backing for four years after Messrs. Gemmell and Jackling made their illuminating report; but in those days the mining industry generally was not interested in ores carrying only from 1½ to 2 per cent of copper, even though ore of that sort was available in a single enormous mass. The thing that deterred De Lamar was that the property could be made to pay only if worked upon an unprecedentedly large scale. Indeed, it was just that that Daniel Jackling visualized in his part of the joint report. It was evident to him that the deposit of low-grade ore could be mined at a profit only after spending on it something like $3,000,000. And how did Jackling propose that the mining should be done? Here is where his genius stands out conspicuously.

Jackling, in his report, described the copper-bearing rock as "a very silicious fine-grained porphyry" that broke into small fragments when blasted. This natural tendency he saw would greatly simplify the subsequent problems of handling the rock during transportation to and treatment in the mill. Up to that time, all mining in the canyon had been done underground, but Jackling foresaw how operations could be carried on more effectually and more economically by quarrying. In short, he pictured nothing less revolutionary than a system by which the mountainous mass could be drilled, blasted, and progressively moved away until it was brought down to the level of the bottom of the gulch, 1,500 feet below the crest of the formation. In order to get out the estimated 12,385,000 tons of ore lying within the hill, Jackling calculated that it would be necessary to excavate and to dispose of approximately 168,000,000 cubic feet of material. Truly, a titanic job!

In April, 1904, the Utah Copper Company completed a 300-ton experimental plant at Bingham; and in the same month the company was reorganized and incorporated under the laws of New Jersey—capitalization being raised to $4,500,000. Copper was then selling at thirteen cents a pound; and under efficient management the mill was treating ore at a cost of but 70 cents a ton. That performance seemed too good to the skeptics who doubted that the property could be worked at such a rate. The industrial outlook was further improved when the Denver & Rio Grande Western extended its line so that Bingham and the mill site at Garfield were linked for the easier transport of mined ore.

For his years of waiting, Colonel Wall received from those who formed the Utah Copper Company a total of $450,000 and retained a 20 per cent holding in both shares and bonds. He was elected a director of the company at its organization, and so remained until he voluntarily resigned five years later. It must have been a source of infinite satisfaction to him to see his hopes so largely realized and to share in that accomplishment.

(To be concluded)



1—Where the railroad climbing the mountain crosses a deep break in the hills. 2—The inclined railway leading from the town up to the office building perched on a hillside above Bingham. 3—Air receivers used in testing the brakes of all trains before they descend the canyon on their way to the mills. 4—Making up a trainload of ore at the mine.

Old-time cradle process used in the early days of the mining West, as picturesquely conceived by Robert Hall.

HUGE WATER-POWER PROJECT IN THE SWISS ALPS

SWITZERLAND, one of the most highly electrified countries in the world, is increasing her developed water power by 360,000 hp. with the construction of an extensive hydro-electric project near the Grimsel Pass, which unites the Valley of the Rhone with that of the Aare, a tributary of the Rhine. From one end of the undertaking to the other is a matter of substantially 12½ miles; and, at different levels along the route, advantage will be taken of a head of water of nearly 4,000 feet. When completed, it will be, it is claimed, the largest thing of its kind in Europe.

As a preliminary, it has been necessary to build a funicular—the steepest on the continent—in order to get materials and supplies to the site at which the Grimsel Dam will rise to a height of 371 feet. In its ascent of 1,476.5 feet from the Handeck to the Gelmersee plateau, the funicular covers a distance of 3,281 feet! It is designed to carry loads not exceeding 10 tons; and, as a precautionary measure, the carriages are provided with quick-acting brakes that enable the cars to come to a stop at the end of a run of only 12 inches after application.

This is just one of the many difficulties the construction engineers are having to contend with on this job high up in the Swiss Alps. Most of them they can cope with, but one they cannot overcome. Owing to the severe weather conditions at that altitude, progress on the work will be exceedingly slow, as it will be possible to carry on operations for but three months out of the twelve. The building period of the Grimsel Dam, for example, will have to be stretched out over four years instead of one, the estimated actual working time.

POTASH BEDS IN URALS OF GREAT PROMISE

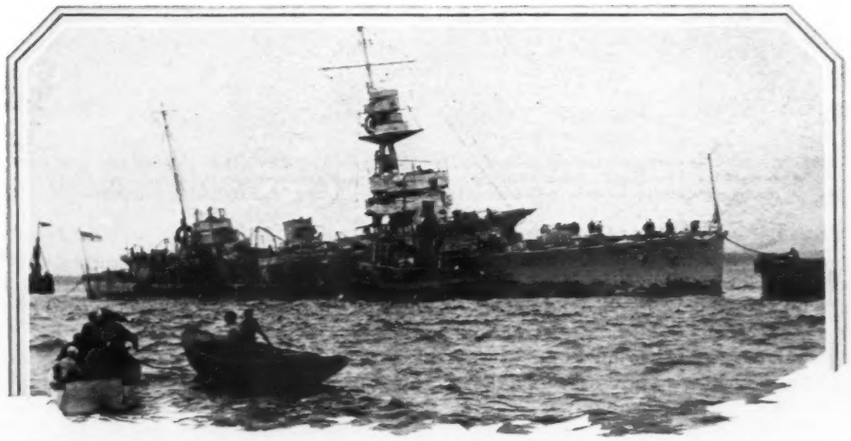
RAPID progress is being made in the development of the Solikamsk potash beds, in the northwestern part of the Urals, which—report has it—promise to rival if not to outclass the Alsace deposits which have for decades furnished much of the world's supply of this plant food.

Two shafts have been sunk to a depth of about 394 feet, the level of the first workable vein; and the first shipment is scheduled to leave the property before the close of the present year. During the fiscal year 1929-30, production is expected to reach 500,000 tons of potassium salts, and the indications are that the output will be increased to 1,200,000 or 1,500,000 tons annually as soon as the plant is working to capacity. The local potash reserve is estimated at from 350,000,000 to 450,000,000 tons.

British Cruiser "Dauntless" Freed from Rocks by Compressed Air

By THE STAFF

HOW H.M.S. *Dauntless* was lifted from the rocks with compressed air is a story that many of our readers have not heard heretofore. It is just one more instance of the part now so often played in marine salvage by compressed air. This buoyant medium served in the case of the stricken cruiser to expel hundreds of tons of intrusive water and so to lighten the craft that she might float clear of the rocks that had pierced her hull and held her fast in their grip.



H. M. S. "Dauntless" soon after portable compressors were put in service to force invading sea water from her injured compartments.

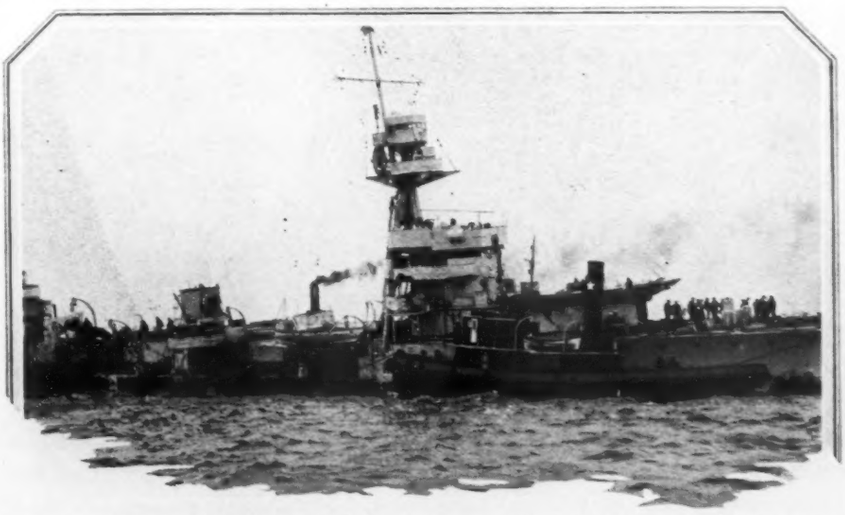
Last year, in the latter part of June, the *Dauntless* headed northward from West Indian waters for a cooling summer cruise along the Canadian coast. All went well until the ship arrived off the entrance to Halifax early in the afternoon of July 2. There she ran into a heavy fog, with rock-ribbed shores close at hand on nearly every side. The pilot schooner, stationed off that Nova Scotian port, asked the cruiser if she wished a pilot; but, in accordance with naval custom, that help was declined and the ship continued nosing onward toward the harbor. Somehow, the man-o'-war got off her course, and was abruptly halted when she suddenly piled up on the rocks of Thrum Cap.

The impact ripped a 35-foot hole in the cruiser's bottom, amidships; and her position with her bow up on the rocks seemed to doom her as a total loss. It was decided, however, to try to lighten the vessel by stripping her of her guns, smokestack, and such other removable weights as would be likely to lighten the 5,000-ton craft. Incidentally, steps were taken to close doors that were open in some of the bulkheads. With these preliminaries completed it was planned to fill the flooded compartments with compressed air and thus force out through the punctured hull plating much of the water that had entered the ship. The scheme was all right in principle, because the aim was to duplicate what had been done on previous occasions in kindred circumstances, but the crucial question was where to get promptly the means of providing the necessary compressed air. Haste was vital to success, because a strong wind would be likely to kick up a pounding sea that would damage the craft so as to make her salvage utterly impossible.

The Halifax Shipyards, Ltd., was given a contract to get the vessel off the rocks, if practicable; and that concern learned that the Foundation Company of Canada, Ltd., was just then unloading two new 10x8-inch Type Twenty portable compressors at its Dorval yard, near Montreal. The Foundation Company readily agreed to lend the two compressors to the salvors; and the machines were immediately reloaded and the car containing them was attached to an express train of the Canadian National Railways—arriving in Halifax on the evening of July 8. The next day the units were on board the wreck and at work.

The outstanding points in this novel use of portables are that the machines were able to meet an emergency and to provide the compressed air required immediately; and they stood up admirably to the strenuous task assigned them even though they were new units and were called upon to work under a heavy load for a protracted period without a chance of gradual adaptation. The situation is fully explained in the report of the service engineer who had the job of starting the compressors after they were placed upon the deck of the cruiser. Let us quote:

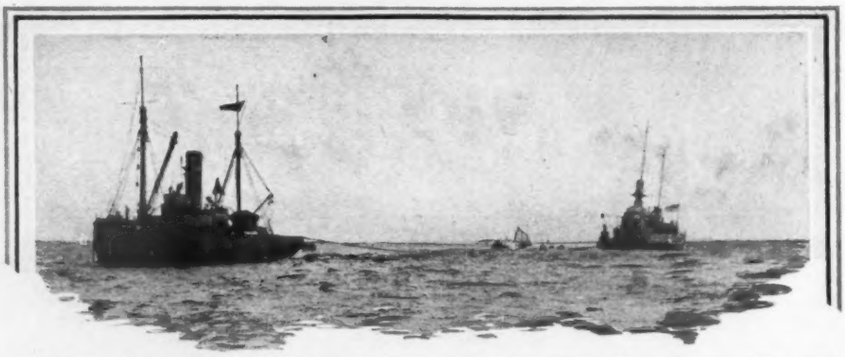
"Immediately after both compressors had been hoisted aboard the *Dauntless*, I got the assistance of four men and was able to get one unit operating within twenty minutes and the second one within slightly over an hour. Both machines had oil; and it was necessary only to assemble the fittings, to obtain gasoline and water, and to turn them over. We had no trouble in starting. We were compelled to put the load on both compressors as soon as the motors had warmed up; and we had to use salt water for cooling, as no fresh water was available. The salvors wanted air at a pressure of 100 pounds, so I boosted the pressure to that point, but the hose lines would not stand it, and I therefore reduced the pressure to 80 pounds. The air was pumped into compartments forward of the smokestack; and both compressors were run steadily until the wreck was sufficiently buoyant to be dragged off the rocks."



The cruiser awash and on the rocks. Compressed air is being pumped into the ship to displace the sea water in certain of her injured compartments.

The *Dauntless* was so pivoted upon the rocks that held her that she rolled restlessly and well-nigh continuously in the surge of the open sea to which she was exposed; and this added considerably to the difficult circumstances under which the compressors had to perform. Accord-

ing to the report just quoted: "Both compressors worked under conditions far from favorable. They did not stand level because the cruiser had a very decided list. It was impossible to correct the inclination by putting heavy timbers under the machines, because the sea kept the vessel rolling without cease from side to side."



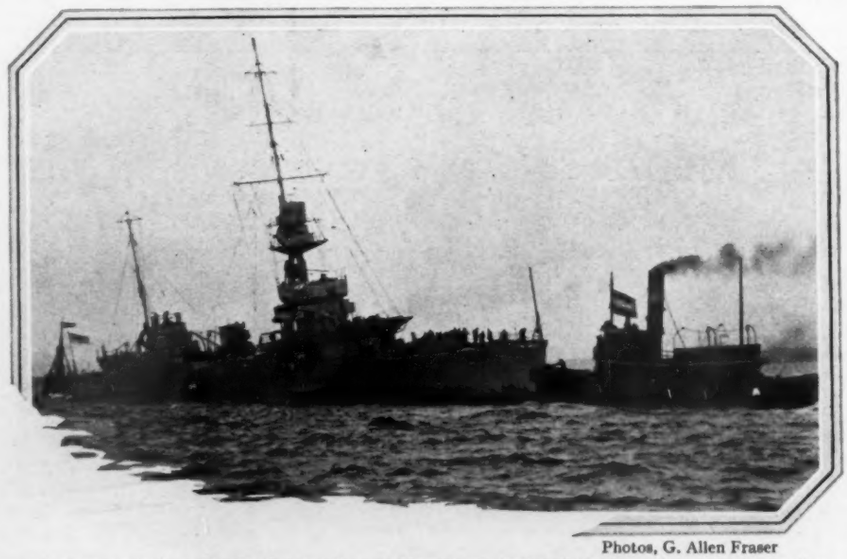
H. M. S. "Dauntless" being towed stern first into Halifax after she was pulled off the rocks. The tugs alongside are pumping compressed air into the damaged compartments and supplementing the air being furnished by portable compressors.

It is not hard to understand why both the salvors and the naval authorities were not only surprised but greatly impressed with the way in which the portables went into service and ran without a halt for fully 36 hours in providing buoyant air at a time when it was sorely needed. The general comment was that it was too bad that the units had to be forced into action without having the benefit of the precautions usually considered necessary in starting up any new and stiff machine.

On the third day after compressed air was forced into the flooded compartments of the *Dauntless*, the cruiser was sufficiently buoyant to be pulled off the rocks by a flotilla of tugs and a number of naval craft. Once clear of the reef, the *Dauntless* was slowly towed to a sheltered position in Dartmouth Cove, where she was temporarily beached until the drydock was freed for her admission. Air was pumped into the wounded compartments until the ship was purposely grounded in 12 feet of water.

After the *Dauntless* was repaired by the Halifax Shipyards, Ltd., she was taken to England under her own power for a general overhauling by the Admiralty. After being thus refitted for service, the ship returned, near the close of last year, to her regular station in the North Atlantic and the West Indies. The reticence that usually surrounds naval matters has made it untimely to tell earlier this story of the outwitting of the sea.

It is interesting here to recall the friendly action of the United States naval authorities who placed at the disposal of the Canadian Government wrecking pontoons from the Boston Navy Yard. As it turned out, these pontoons were not needed, but they were available to aid in the refloating of the *Dauntless* had they been found necessary. Due credit should be given the Canadian shipbuilding and salvage experts for the way in which they met and dealt with a difficult problem; and the Foundation Company, Ltd., deserves commendation for its readiness to hold up its own work by lending the compressors that did so much to save the imperiled man-o'-war.



Photos, G. Allen Fraser

Tugs assembling about the cruiser preparatory to forcibly dragging her from the rocks after she had been made more buoyant by means of compressed air.

LIGHT BEAM REGISTERS TRAFFIC

AN ingenious electric traffic counter that registers on a distant dial the number of vehicles entering the Holland Tunnel is being tried out and, apparently, with success. The apparatus, devised by the General Electric Company, consists of a small flood light mounted in an inclined position so that its beam will fall upon a small circular window in a box set beneath the sidewalk and at a point opposite the light at the tunnel entrance. The box contains a photo-electric tube, an amplifying tube, and an electrical relay. Each time a vehicle passes the spot, the beam cast upon the window by the flood light is interrupted, setting up a slight electrical impulse which is amplified by the vacuum tube and fed to the relay which, in turn, energizes a transmission circuit terminating in the nearby administration building. There the current so induced actuates a dial which registers one more figure every time the cycle of operations is repeated—that is, every time a vehicle throws a shadow on the little box.

If satisfactory, it is planned to place such counters at definite points throughout the tunnels so that there will always be available a record of the number of vehicles in any one section at a given time. This information would be of exceptional value in case of a tie-up when the volume of ventilating air supplied would have to be increased sufficiently to take care of the excess monoxide gas given off by the halted cars and trucks.

BERYLLIUM RECOMMENDED FOR AIRPLANE USE

THE materials division of the British National Advisory Committee for Aeronautics is planning a comprehensive study of beryllium for airplane use. At the present time that metal occupies much the same position as aluminum did about 40 years ago—being an expensive and rather rare element in its refined state. Surveys show that the potential world supply of the mineral is at least as great as that of zinc. Deposits are known to exist in different parts of the United States, and a large source of supply has been discovered in South Africa.

Tests have indicated that although beryllium is lighter than aluminum it possesses about the same strength, while its modulus of elasticity is three times as great. It is also said to resist corrosion and to be substantially weather-proof. These characteristics, on the face of it, would seem to make beryllium a highly desirable structural material for airplanes.

The second plenary meeting of the World Power Conference is to be held from June 16 to 25, 1930, in Berlin, Germany. The conference will deal principally with the economic rather than the technical side of the question—that is, with the distribution and utilization of power. All papers submitted from the United States must go through the American committee, of which O. C. Merrill of Washington, D. C., is general chairman.

Putting Up Pin Money Pickles

Compressed Air Performs an Important Part in This Industry Which Has a Romantic Background

By A. S. TAYLOR

THERE is a spot in Richmond, Va., where the surrounding air is continually redolent with the appetizing aroma of spices and the peculiarly tempting tang of steaming, seasoned cider vinegar. Back of those delectable scents lies the story of an industrial romance and evidence of what an enterprising woman can achieve when she has the will to do so. The spot in question is the present-day plant of Pin Money Pickles, Inc., where certain famous pickles are made to tempt palates the world over.

The history of the concern is a colorful one and covers a period of 57 years; but the reason for the undertaking dates back decades earlier when the mistress of every well-to-do southern home could point with pride to the tempting things stored on her pantry shelves and made in accordance with well-tried and approved recipes. Many of those formulas were treasured family possessions, handed down through several generations. Most of the recipes were very exacting as to how the various ingredients were to be chosen, proportioned, and prepared. Close attention to every detail and a goodly amount of time were called for in order to insure success—at no stage should the prescribed sequence of operations be hurried. Nothing could have fitted better into the habit of life of the Southland in those leisurely and glamorous days.

Sixty-odd years ago, Miss Ellen Gertrude Tompkins—then a slip of a girl—stood by the stove in the kitchen of the family homestead in Richmond, stirring and occasionally tasting the contents of the teeming kettle that broadcasted pungent and spicy odors throughout the old-fashioned mansion. The occasion was a serious one, because Miss Ellen was making sweet pickles after a recipe that had come down from her great-grandmother, and there was a family reputation to maintain. There is ample warrant to believe that her efforts then were crowned with success; and it is equally certain that her skill grew from season to season as she put up pickles such as her women forebears had made in their days.

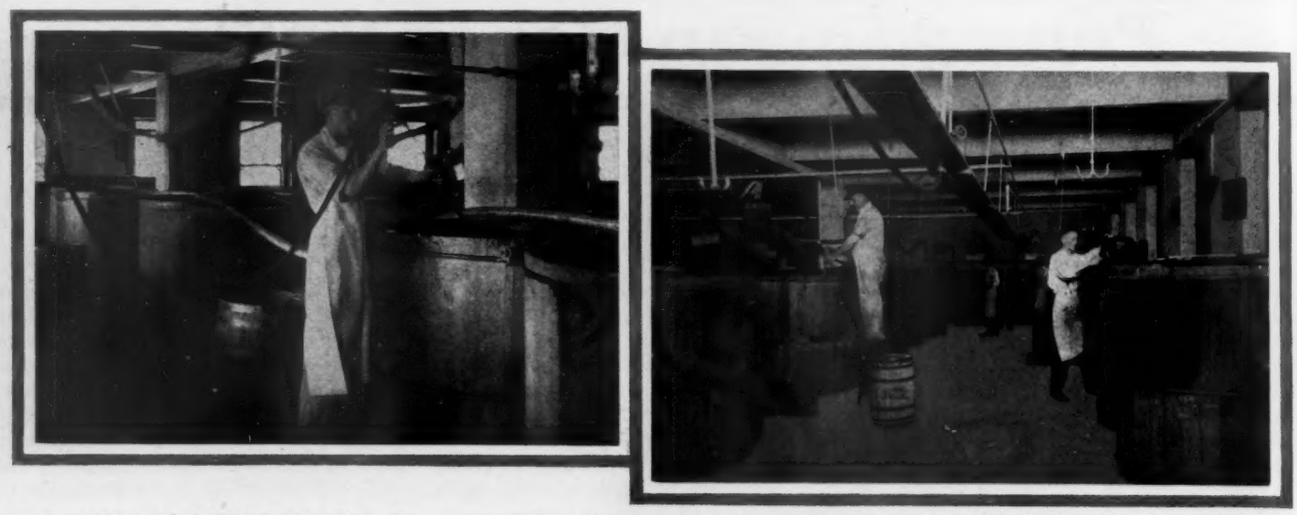
There came a time subsequently when Miss Ellen sent samples of her pickles to the Virginia State Fair regularly during a decade; and on each occasion she won a premium by virtue of their excellence. The climax of her early work in this field came when a hotel in a fashionable watering place of the Old Dominion ordered a whole keg of what she then called her "Old Virginia Pickles"! That was, indeed, a feather in her cap, and ample reason for prideful delight.

Somewhat later, a friend and neighbor came to her in haste for a jar of pickles to add zest to a supper hastily arranged for unexpected guests. Miss Ellen was loath to accept compensation, but her neighbor, in parting, pressed a banknote in the young lady's hand, saying: "This is for pin money". In that way the trade name of Pin Money Pickles originated; and for some while thereafter the putting up of pickles was primarily for the purpose of earning funds that she could do with as she pleased. In due course of time, Ellen Gertrude Tompkins married John B. Kidd, also of Richmond.

To tell Mrs. Kidd's story in true southern style, we should recite her genealogy as well as that of her husband on both sides of the two families, paying proper attention to lovely aunts and distinguished uncles; but space here forbids. We must, therefore, limit this account to what Mrs. Kidd accomplished largely during a period of our social life when women in business were few and far between and not supposed to be qualified by nature to manage an industrial undertaking.

That Mrs. Kidd made a success of her venture is evidenced in many directions, but none proves this more effectually than the favor that Pin Money Pickles have won wherever they have become known. Mrs. Kidd attributes this recognition to the close personal supervision that she gave in the years past to every stage in the preparation of her appetizing commodities. In short, she did in the factory just what she had done in her father's home. That is to say, she put her

The first operation in pickling requires that the green stuffs shall be put in brine that is progressively strengthened until the salty fluid reaches a prescribed maximum density.



Left—Agitating gherkins with a jet of compressed air. This procedure does not injure the pickles and saves the operator much back-breaking labor. Right—The pickling commodities are in wooden vats filled with spiced and sweetened vinegar, and every day they are examined carefully by qualified experts.

heart and her mind in her work.

In her early married days, Mrs. Kidd did her pickling in her own kitchen; and when the demand outgrew the capacity of that place she had a small plant built in her back yard. When the excellence of her products won still wider favor, the back-yard factory gave way to a more capacious plant. Finally, before Mrs. Kidd relinquished active control of the business created by her, she had the satisfaction of seeing the present large 5-story establishment constructed and even operating at the limit of its capacity. Today, in her ripe maturity of 75 years, Mrs. Kidd is making the most of her well-earned leisure, and concerns herself principally with her grandchildren and the flowers in her conservatory.

Perhaps it will interest others to learn a little about some of the mileposts that mark the degree of recognition that came to Mrs. Kidd at critical stages in her business career, which really began in the early "seventies." This will serve to emphasize the progress made since then. Sometime during 1872, Mrs. Kidd received a $17 order from a well-known grocery house in New York City—that order was a big one then. The purchaser wrote that there was no general demand for sweet pickles in the Metropolis except among resident Southerners, thus making it plain that the shipment was not likely to be followed by many others. Today, New York City is the largest market for the commodities put up by Pin Money Pickles, Inc.

Subsequently, there was received from a concern in Seattle a telegram that read as follows: "Ship five barrels". No order had come to her up to that time for more than a keg of pickles, and she and her husband reasoned that some mistake had been made in the telegraph office. Accordingly, a 5-gallon keg was sent to Seattle, and shortly afterwards another wire arrived to this effect: "Barrels, barrels, five. Plain enough? Could eat five gallons myself." Pin Money Pickles are still going to that house in the State of Washington.

Probably no single order has been more instrumental in broadcasting the tempting qualities of Mrs. Kidd's pickles than the first one she received from the Pullman Company some years ago. Mrs. Kidd then on a visit to a friend in Chicago, had taken with her some jars of pickles put up in her factory but with that homemade appeal to the palate that was peculiar to her products. While in the Windy City she met two officials of the Pullman Company and dined with them aboard one of the company's diners. The pickles served were not all that Mrs. Kidd thought they should be. After partaking of them she asked the men to try some of hers, and they did so. As a result she left them with a $400 order, which was doubled before she reached Richmond! No wonder Mrs. Kidd was elated. Thereafter her pickles were named on Pullman menus.

Pin Money Pickles, Inc., makes no effort to win renown through the largeness of its output—the dominating aim is to insure quality and to reproduce on a commercial scale pickles that shall be virtually identical with those put up by Ellen Gertrude Tompkins years ago in the old family homestead. This has been made possible by adherence to the ordered and leisurely procedure established by Mrs. Kidd when she was actively engaged in directing the business, with which she was associated for more than half a century.

As they will tell you at the plant, Pin Money Pickles are cooked in pure cider vinegar, naturally aged. Most of that vinegar comes from a certain place in Pennsylvania, where it is made from sound, clean, and carefully picked apples. The vinegar is aged in 50-gallon barrels; and is from two to three years old when it reaches the plant in Virginia. There it is matured for six months more by exposure to southern sunshine. There is something in that vinegar which plays a prime part in giving to Pin Money Pickles their exceptionally pleasing flavor. The spices and other condiments used are selected with the same care; and they are the freshest and

Packing department where Pin Money Pickles are placed in their glass containers.

1—These workers are putting the toothsome stuffing in the pickled mangoes that have contributed much to the fame of Pin Money Pickles. 2—It is not enough just to fill the jars with Pin Money Pickles: the contents must be uniformly and attractively arranged. 3—After each jar is packed with pickles it is filled to overflowing with very hot spiced vinegar and then capped. 4—Sealing the caps on the still hot jars. 5—From the capper the jars are passed through a washing machine, where compressed air is utilized to hasten their drying.

the finest obtainable. No fewer than nine foreign countries contribute the different ingredients of this sort. The currants come from Greece; the cloves are grown in the Island of Amboina; the pungent ginger is a product of Jamaica; England provides the yellow mustard seed; Japan is the source of the chilies; and the cinnamon, mace, allspice, etc., are imported from those tropical countries that have long been noted for these seasoning substances. Only granulated sugar is employed for sweetening purposes; and the brine used in first pickling the raw commodities is made with air-dried salt that is mined in the Keystone State. According to the time of year they are required, the lemons utilized originate either in Italy or in the orchards of California.

The onions for "Cocktail Onions" and the small cucumbers for "Tiny Tim Gherkins" are grown in Holland; and Dutch farmers also furnish much of the cauliflower required by Pin Money Pickles, Inc. The great bulk of the fruits and vegetables that go into the making of the company's sweet pickles are raised on the fertile acres of the surrounding country; and no fewer than 150 farms are virtually supported by this market. Virginia growers supply cabbage, green tomatoes, pimento peppers, cucumbers, banana cantaloupes, watermelons, mangoes, and whiteheath peaches. The mere recital of these things is enough to make one's mouth water.

All green stuffs received from neighboring farmers are first put in 40 per cent brine for seven days; and the strength of the brine is raised progressively five points each week until it reaches 60 per cent. This pickling process takes about six weeks to insure proper curing; and the brine in each vat is tested daily to make certain that all is well. The impurities that accumulate on top of the brine are skimmed off from time to time. The brine is not stirred while pickling is in progress, but each fresh batch of brine is thoroughly agitated with a strong jet of compressed air discharged from the lower end of a submerged pipe. Various products will spoil at different periods during the brining process; and each must therefore be watched and removed from the brine at the right moment.

Assuming that the several green stuffs have been duly pickled to the point just described, then they are removed from the brine and sterilized in hot water—after which they are washed with cold water and drained. With this done, the cucumbers, cauliflower, tomatoes, etc., are put in hot vinegar that is made up of half sour and half sweetened vinegar, and there they remain for two days. At the start of this stage the vinegar has a temperature of 212° F., and before the fluid cools it serves to partly parboil the green stuffs. In this vinegar mixture are spices. At the end of the second day, the vinegar is drawn off and wholly sweet vinegar, also hot, takes its place, and fresh spices are added. The parboiling is thus continued; and the vinegar and the spices do their work during a period of five days. As a consequence of these two applications of heat, the ingredients are cooked progressively and slowly so as to preserve the green stuffs and to mellow them—the vinegar and the spices carrying their flavors deeply into the pickles.

Until a few years ago, the pickles while in the cooled vinegar were stirred daily by hand. This was a back-breaking operation and, besides, damaged a considerable percentage of some of the ingredients and made them unfit for use in certain of the commodities. After trying to do this essential work with mechanical equipment, which did not answer satisfactorily, the company determined to try compressed air for this service, and installed a compressor. The compressed air is discharged into the tank from a straight length of pipe connected with a flexible air line, and the air escaping near the bottom of the tank thoroughly agitates the vinegar and the pickles without injuring the latter in the least. Brine tends to cause the pickles to shrink, while the action of the compressed air, for some reason, restores the plumpness and the mellowness to the pickles. When the second vinegar pickling and cooking is concluded, then the Pin Money products are drained and packed by hand in glass jars; and when this work is done the containers are filled to the brim with hot vinegar and fresh spices. The jars are capped while still hot, and this induces a protecting partial vacuum when cooled, thus adding to the security of the seal. After capping, the jars are run through a washing machine. On leaving the washing machine, the containers are exposed successively to blasts of compressed air and blower air that serve to rough dry them. The final operations consist of labeling and packing the different products. For the sake of those that may be interested, these are: mixed pickle, chow-chow, picalilli relish, Tiny Tim gherkins, cauliflower, baby melons, silver skin onions, bur gherkins, bur mangoes, medium gherkins, watermelon, cucumber slices, and melon mangoes—all sweet; and two sour varieties, Tiny Tim gherkins and cocktail onions.

The main building of the plant where Pin Money Pickles are now made. Another building on the right-hand side of the street is also utilized for some stages of the preparatory work.

Last year, the plant cut up 30,000 watermelons to obtain the rind which alone is used in making watermelon pickle. The mangoes are picked when only one day old—just after they have dropped their bloom, and the sizes range from 1 inch to 1½ inches in diameter. Pickled mangoes are among the most delicious of the commodities sold by Pin Money Pickles, Inc. Cucumbers brought in by Virginia farmers are mechanically screened to three sizes; and these are again assorted by hand into other and more numerous sizes. This is necessary particularly in bottling certain varieties of pickle that must contain just so many small cucumbers per bottle, and which must be packed so as to insure a nearly uniform appearance.

It is no exaggeration to say that the Richmond plant of Pin Money Pickles, Inc., is the direct outgrowth of the steaming spicy kettle of Ellen Gertrude Tompkin's girlhood days; and the well-earned reputation of the present-day commodities of that concern are likewise due to the painstaking methods devised by Mrs. Kidd to meet large-scale operations. A period of six months on an average elapses between the reception of the green stuffs and the readiness of the pickles for shipment to consumers. Time is essential to the results desired. No wonder Pin Money Pickles can be confidently counted upon to tickle any sensate palate.

WHAT TO DO WITH EMPTY CRATES AND BOXES

THE man or boy, not to mention woman, handy with the hammer and other tools to be found in the household tool box, should be interested in a pamphlet entitled, *You Can Make It.* This booklet is the first of a series on the utilization of old boxes and crates issued by the National Committee on Wood Utilization of the Department of Commerce. For the price of ten cents, a copy of it may be obtained from the superintendent of Documents, Government Printing Office, Washington, D. C.

You Can Make It contains more than 100 suggestions on how to fashion from boxes and crates, that are usually discarded, pieces of furniture, camp equipment, amusement devices, and articles for garden and home use generally. The purpose of the pamphlet is to help put to further use the more than 4,000,000,000 feet of lumber that goes into box and crate construction each year in the United States. If this wood were suitable for building purposes it would provide homes for a city of 2,000,000 people!

Work has been begun on the survey of the proposed route of the Nicaragua Canal.

Creosote Oil Gives Timber Longer Service Life

Vacuum Pumps and Compressors Perform Important Functions in Treating Timber with Preservatives

By S. W. LABROT, JR., and F. A. DENCER

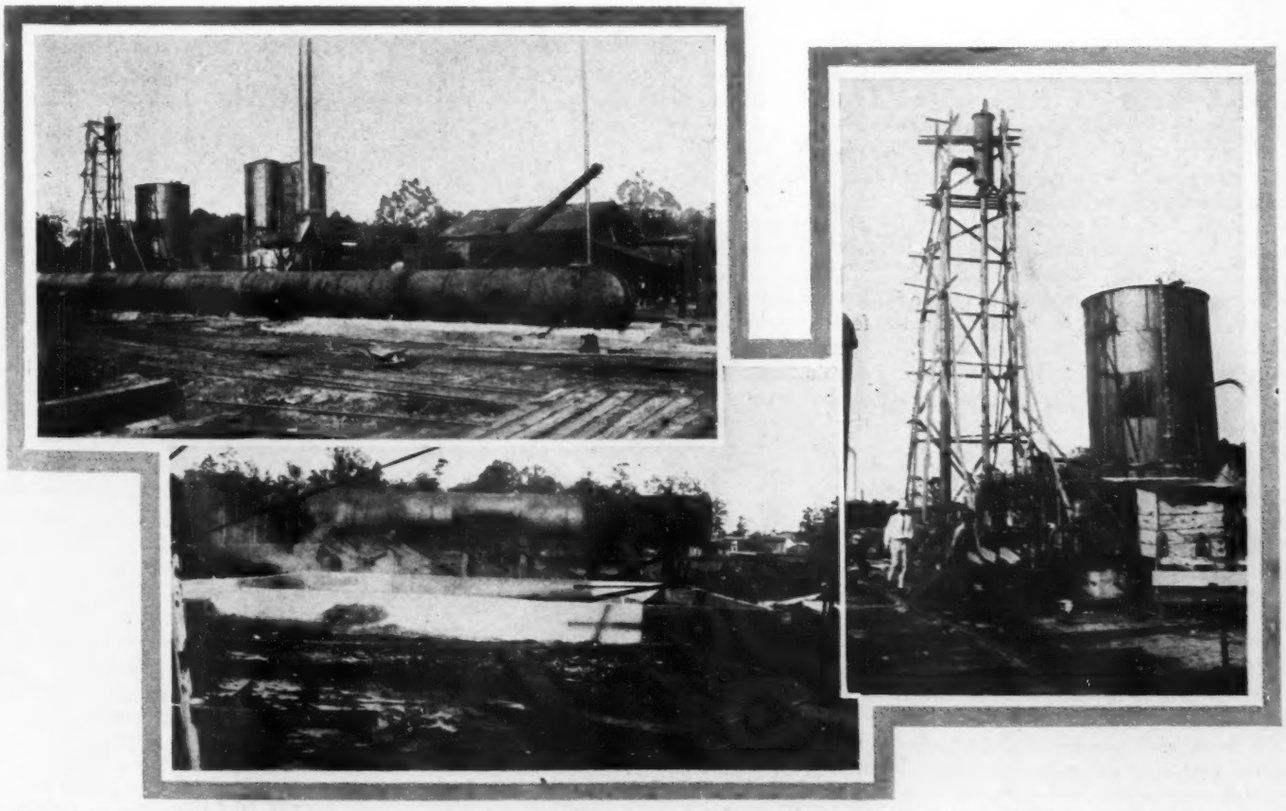
OUR forests are dwindling annually and our domestic sources of timber are narrowing accordingly. Even so, wood for many purposes is superior to any other material that might be employed in its stead. Therefore, there has come into being a branch of industry that is especially devoted to treating certain forms of lumber so that their periods of usefulness will be increased to a marked extent. This is achieved by impregnating the lumber with protective fluids that add notably to the wood's capacity to resist the actions and agencies which induce decay or other sorts of physical impairment.

The present article has to do with the use of creosote oil in preserving poles, piling, railroad ties, and planking; and it describes how these are impregnated with the preservative oil. As must readily be grasped, the uses of timber vary with geographical localities; and the changing fields of service affect the quantities of oil that must be utilized to offset either decay or the injurious attacks of insects and bacteria. For example, marine timber structures are differently treated from the timber for land structures in order to protect them from deterioration or destruction. Timber is destroyed by oxidation—popularly termed rotting, through the activities of pests of various kinds, as well as through shock. The latter is something that creosote oil or any other kindred preservative cannot combat.

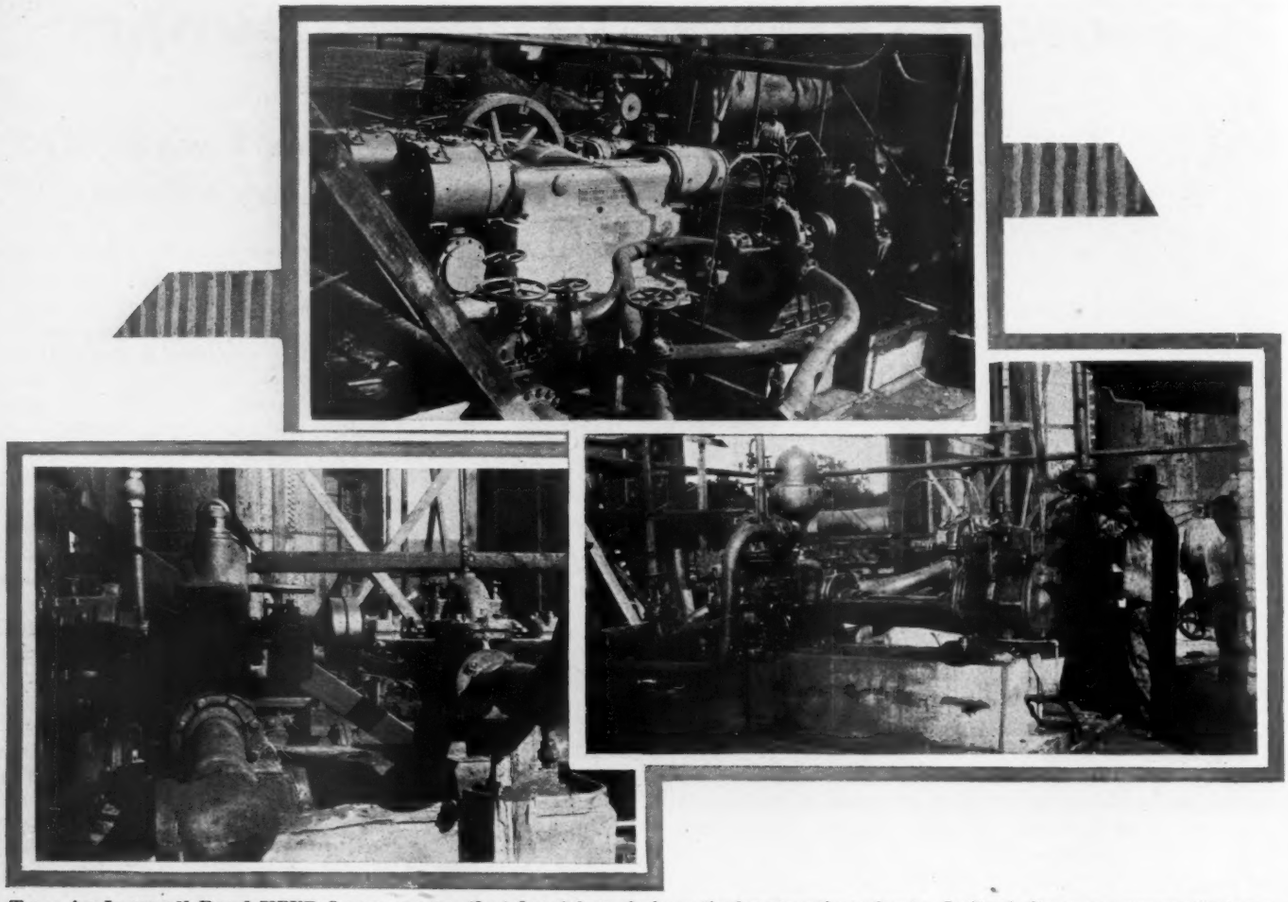
Timber is peculiarly suited by nature to serve for railroad ties. It is resilient, easily handled, and can be readily penetrated by the spikes that hold the rails in place. Furthermore, the ties, because of their resilience, function as shock absorbers between the rails and the roadbed when it is subjected to the shifting loads and blows of a passing train. But ties are laid where they are intermittently exposed to wetting and drying—that is, to the conditions that promote decay. Therefore, it is considered good practice to creosote them so as to keep them sound and thus to defer the day when they will no longer be able to withstand the shattering blows of present-day heavy, high-speed traffic.

In the center of every telegraph, telephone, or power-line pole there is a circular area of pith or dried cellulose that runs the whole length of the pole. If unprotected, this wood soon rots away leaving a weakening cavity. For this reason, poles for these services are generally tapered at the top—often finished with an apex—so that falling rain will run off quickly and not linger and penetrate. In the case of pilings, the top of each—especially if it be flat—is frequently covered with sheet metal in order to shed the rain. These precautions merely emphasize a characteristic weakness of wood, particularly when the end of the grain is exposed to the weather.

Even when protected at the upper end, a pole or pile is apt to rot at the ground line or at the water level. It is at this point that the timber is subjected to alternate conditions of wetness and dryness, and these induce decay. It should be remembered that removing and replacing a pile or a pole in a structure costs ten times as much as it did to



Top—Pressure cylinder in a timber-creosoting plant. The cylinder is 8 feet in diameter and 170 feet long. Right—Condenser in course of erection. Bottom—Concrete cold well with storage tank in the background.



Top—An Ingersoll-Rand XPVR-3 compressor that furnishes air in a timber-treating plant. Left—A Cameron pump that supplies cooling water to a condenser. Right—This No. 9 GSS Cameron pump delivers 103 gallons of creosote oil a minute against a pressure of 200 pounds.

put it there originally; and it is quite practicable to treat the entire pile or pole with creosote oil instead of only the butt. It is true that this treatment of the butt does safeguard the danger line just referred to, but the cellulose center above ground decays quickly and weakens the timber while permitting water to get in and to promote rotting from the heart outward. In other words, the upper part of the pole becomes a happy hunting ground for pests that like good, clean wood but dislike timber that is soaked with creosote oil.

The pests that attack timber are many. The woodpecker has no way of reading a sign on a pole advising him whether or not worms are present. But he gets a great deal of enjoyment from hammering away in his search. Worms are not in creosoted poles. The termite or white ant is found the world over. This active creature lives in the ground and works up into the wood, satisfying his hunger as he goes. In a home built of lumber, sills touching the ground should be creosoted to stop the ravages of this pest. The *limnoria*, which looks like a hard-backed bug, works on the outside of the piling in eating it away. Again, in the case of marine structures, the *teredo* seed, the size of a rice grain, gets on the timber at the water line; and as this creature eats its way into the wood fiber—its end the while staying fixed—it may grow from a few inches to several feet in length and as big in cross section as a thumb nail. Forces of nature alone do not destroy lumber, but sea water damages concrete—the *pholada*, a clamlike pest, having been known to eat concrete in our southern and western waters. Steel, of course, is subject to rust or oxidation unless covered with paint of some sort frequently.

It can be seen that creosoting timber answers a need. With the rapid depletion of our forest reserves it is impossible to estimate accurately the value of preserving timber. We do know that our lumber companies are leaving trees on each acre instead of taking them all as they did in former times, thus admitting the fact that this construction material is none too abundant.

The extent to which timber is treated depends upon certain factors. Purchasers have their specifications. A railroad tie might contain from 5 pounds to 8 pounds of oil per cubic foot if made of long- or short-leaf pine. Six pounds is, we believe, the average. In a red-oak tie, 6 pounds per cubic foot gives good results. Poles usually are impregnated with from 6 to 8 pounds of oil per cubic foot; but for humid, hot, tropical regions 12 pounds of oil is used, as a rule. For land work in mud or in fresh water piling and lumber do nicely with 12 pounds per cubic foot, while for marine work in salt water lumber usually needs 12 pounds and piling gets from 16 to 24 pounds per cubic foot.

At this point it might be well to picture an average cresosote plant. Such an industry must be located near a lumber supply and on an adequate transportation system so that the raw material can be readily brought in and the finished product quickly sent to the purchaser. Storage tanks for oil, with steam pipes therein, are necessary; and a well-drained space is required for keeping raw material in readiness.

A form of locomotive or crane moves the material around the yard and into and out of the treating cylinder. This cylinder or retort, made of steel plates, is usually from 6 to 9 feet in diameter and from 125 to 180 feet in length. On the ends are heavy, hinged doors; and inside is a track along which are hauled the trucks or small cars carrying the timber. To this cylinder run pipes for steam, pipes for pumping in air and oil, a large pipe for removing vapor, and various drain pipes and vents. In addition, the equipment includes an air compressor, oil pumps, boilers, boiler feed pumps, a condenser, vacuum pump or steam jets for removing air and vapor, and cooling-water pumps.

Let us put some ties of green timber into the cylinder and see what happens. The ties usually take up from one-third to three-fifths of the total cylinder volume. We must remove the moisture, if the timber is green,

and, for this purpose, steam at about 40 pounds pressure is admitted and kept there approximately one hour per inch of thickness of the tie. The steam is then freed to the atmosphere and the condenser vacuum pump brought into play, pulling a vacuum of 24 inches or more to dry the wood and to remove the sap. The vacuum lowers the boiling point of the drops of moisture in the wood, inducing them to pop out as vapor. When the sap no longer comes over into the condenser hot well, the condenser and the vacuum pump have finished their work. The timber is now in condition for treatment. Dry or seasoned timber does not need to undergo the foregoing; and from this point on the treatment for dry and green timber is the same.

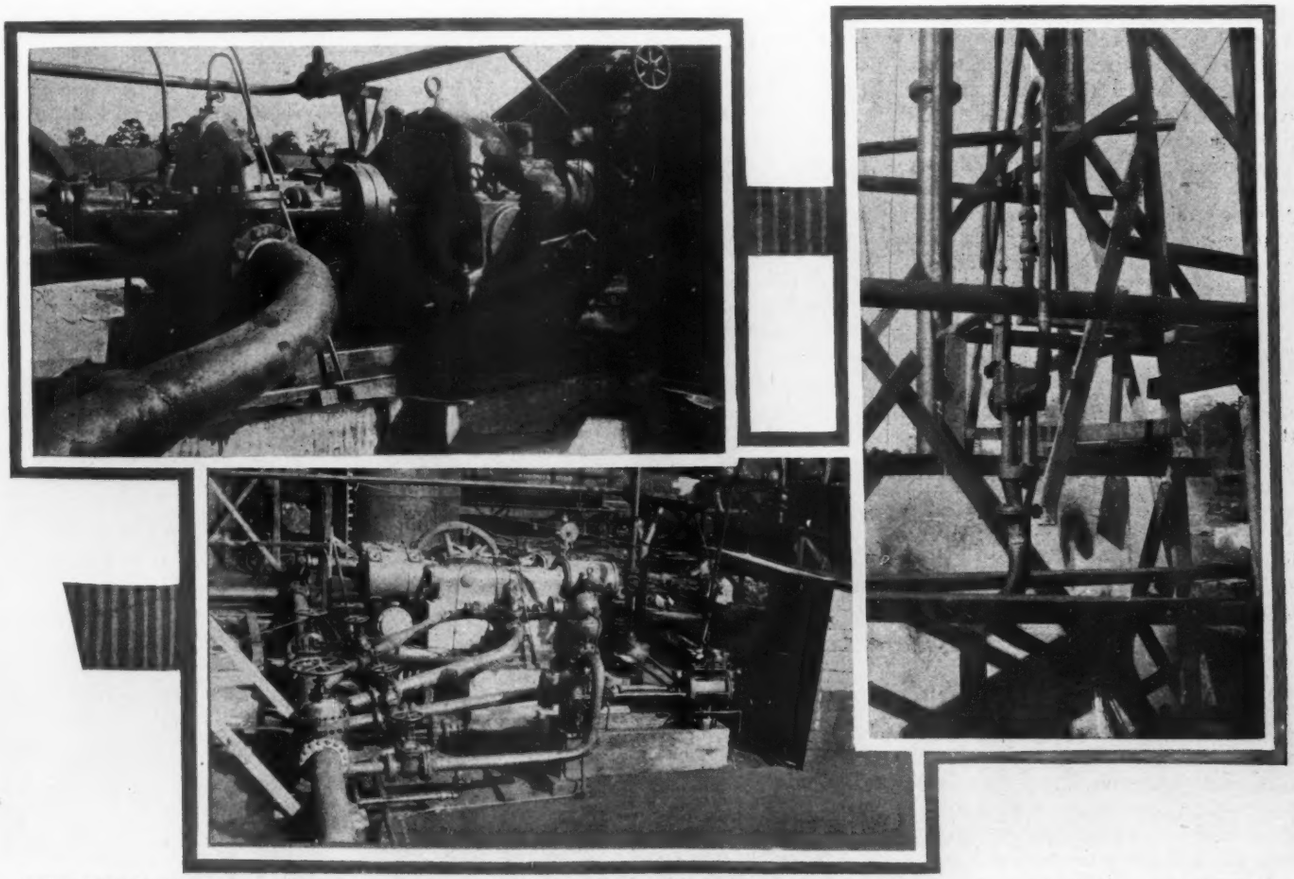
The retort is filled with compressed air under a pressure of 50 to 100 pounds, depending upon the kind of material and the results desired. This air gets into the wood cells. Oil at 200° F., taken from the steam-heated tanks, is forced into the cylinder with centrifugal or steam pumps; and while the air pressure is maintained, the air displaced by the oil is freed to the atmosphere. When the overflow pipe on the cylinder shows the cylinder to be full of oil, the valve on the pipe is closed and the oil pressure is run up to a maximum of 200 pounds per square inch. The pressure is held until the timber refuses more oil or until the gage on the tanks indicates that the desired quantity has been pumped in.

The timber going into the retort has a known volume. If we have 4,000 cubic feet of timber, and want a treatment of 6 pounds per cubic foot, we pump in approximately 2½ times the required amount, or 15 pounds of oil per cubic foot, making a total of 60,000 pounds of oil for that load. When the surplus oil around the wood is withdrawn from the retort and returned to storage by a transfer pump, the air trapped in the cells expands and "kicks out" the surplus oil in the wood. The wood is thus thoroughly penetrated with preservative while the cells are free of oil. In the event more oil is left in the timber than required, a vacuum is pulled on the cylinder to get out the excess. We have described briefly the "empty-cell" process, a treatment giving excellent depth of penetration with a minimum retention of preservative.

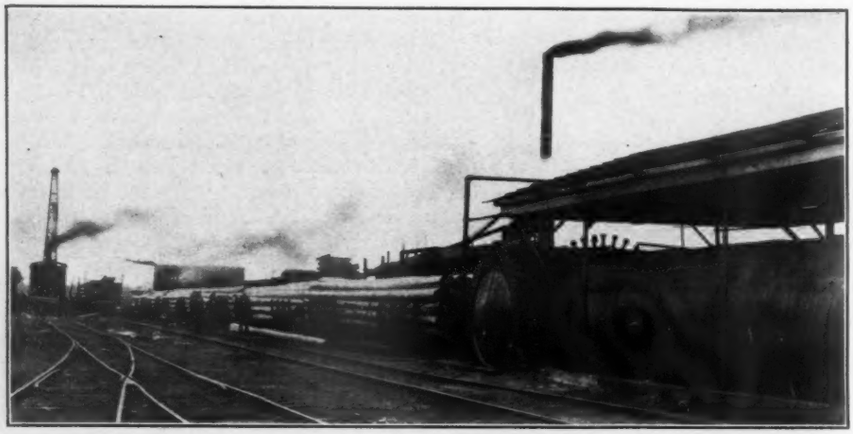
Let us now follow through the process a pole which carries wire, or a pile used to support heavy structures. It needs from 16 to 24 pounds per cubic foot, as previously explained. A creosote plant has charts for computing the contents of a pole by knowing the diameter of the butt and the diameter of the top. Therefore, when a load is run into the cylinder its cubical contents are known. The doors are closed. If the timber be green, it is steamed and put under vacuum, and, if dry, it is put only under vacuum which, in either case, is usually of 24 or 26 inches. The desired quantity of oil is then pumped into the cylinder, and the pressure raised to 150 or 200 pounds per square inch. The vacuum helps to pull the oil into the cells; and, when the gage on the tanks indicates that the proper amount has been forced into the timber, the work is completed. Then the oil is drained from the retort. This is what is termed the "full-cell" process, and differs from the empty-cell treatment in that the oil is retained in the cells and is not blown out of them by expanding air.

The American Creosote Works, Inc., has plants at Winnfield, La.; Louisville, Miss.; Southport-New Orleans, La.; Savannah, Ga.; and Norfolk, Va. The three plants at Winnfield, New Orleans, and Louisville, can treat a total of 85,000,000 board feet a year. Inasmuch as a car can carry about 12,000 board feet, it would take 7,000 to move this quantity of timber. If all that lumber consisted of boards 1 inch thick and 12 inches wide, and if these were placed end to end, they would encircle about two-thirds of the earth's equator. The five plants can handle an aggregate of 175,000,000 board feet in the course of a year—enough, in short, to encompass the equator and overlap it for a third of its circumference.

After the Winnfield plant had been seriously damaged by fire, the company decided to reconstruct it and to provide it with thor-



Left—This No. 5 HV Cameron pump handles creosote oil at the rate of 1,000 gallons a minute against a pressure of 100 pounds. Right—Part of the steam-jet equipment in a wood-treating plant with the hot well and tailpipe in the background. Bottom—High- and low-pressure oil pumps.



Large cylinder at the right is the chamber in which the poles on the left are to be treated with creosote oil.

oughly up-to-date equipment. The following particulars should be of interest to those of our readers similarly engaged or who utilize treated lumber for one purpose or another. Not only has the capacity of the plant been increased but the apparatus installed insures products of a high grade. The compressor is of the Imperial type, is steam driven, and has a piston displacement of 823 cubic feet per minute. This machine will deliver sufficient air to the retort to insure a pressure of 100 pounds per square inch in from 30 to 40 minutes—depending upon the load of timber, which takes up space that the compressed air does not have to fill except so far as the cells in the lumber are concerned.

The low-pressure, centrifugal oil pump has a 6-inch suction and a 5-inch discharge, and is driven by a 100-hp. steam turbine. This pump will put about 180,000 pounds of oil in the cylinder in 20 minutes and raise the pressure to 100 pounds. The high-pressure pump, which raises the pressure from 100 to 200 pounds, can handle 104 gallons of oil per minute. It is a simplex steam pump with a 12-inch steam cylinder and a 7-inch oil cylinder, and operates on a 13-inch stroke. This pump is smaller than the low-pressure pump because certain timber will not take the oil as easily at high pressure as at low pressure. For instance, when treating oak ties, the high-pressure pump runs very slowly.

The condensing plant is composed of a counter-current barometric condenser, a cooling pump, and steam jets. Air and vapor are removed by one 2-inch primary and one 3-inch primary jet, along with one 3-inch secondary and one 4-inch secondary jet. These jets are flexible and can be used independently, in pairs, or all together—varying water temperatures, different vacuums, different leakages, and different timber loads determining the jet capacity. The jets were designed for a vacuum of 24 inches in 15 minutes, and 28 inches thereafter—depending upon the temperature of the cooling water. The cooling-water pump is a steam-turbine-driven centrifugal with a 4-inch suction and a 3-inch discharge, and takes its water from a concrete cold well or pond. After the water goes through the condenser and to the hot well, it flows by gravity back to the cold well. The pump needs to handle only 200 to 250 gallons of water per minute; and the condenser, due to its vacuum, helps to pull the cooling water into the nozzles, from which point it falls down in sheets by gravity. The vacuum effect of the condenser cuts down the power required to handle the cooling water.

The New Orleans plant—designed to take care of both export and domestic business, is of larger capacity than the Winnfield plant, and in it has recently been installed a high-pressure centrifugal pump and a large compressor. The new compressor has a piston displacement of 1,156 cubic feet per minute, at 200 revolutions, and is also of the Imperial type. When this unit is not needed for forcing air into the wood cells, as is done in the empty-cell process, or for blowing oil, it is used to operate an air lift. The piping is so arranged that the starting pressure is 120 pounds per square inch, while the running pressure thereafter is about 94 pounds. The compressor, operating at very slow speed, pumps water into a storage tank 200 feet from the well, whence a duplex steam pump lifts it to an elevated tank 75 feet above ground. This tank then supplies water for all plant purposes.

From the New Orleans Association of Commerce it is learned that, during 1926, a total of 551,483 railroad ties were exported in addition to 882,000 board feet of southern pine and 49,000 board feet of other sawed material, all preserved with creosote. During the same period, 32,426,953 gallons of creosote oil came into that port. These figures indicate the steadily growing importance of this method of lengthening the life of timber.

The officers of the American Creosote Works, Inc., are: S. W. Labrot, Sr., president; S. C. Braselman and S. W. Labrot, Jr., vice-presidents; H. L. Slingluff, manager; and J. E. Cooke, traffic manager.

AIR-OPERATED DRILLS IN SPECIAL SERVICE

AIR drills are proving a satisfactory source of power in the plant of the Detroit Lubricator Company, where they are used in the production of radiator valves. For the tightening of the valve bonnets there has been provided special machinery in which is mounted a large-size pneumatic drill. This drill is started and stopped by remote control conveniently placed at the operator's left hand, leaving her right hand free to feed the machine. A reducing valve serves to regulate the air pressure, which may vary anywhere from 20 to 80 pounds depending upon the size of the valve being assembled. The entire mechanism moves in a counterweighted vertical slide, and is brought in position by means of a kick-pedal. When the work is completed, a suitable bleeder valve releases the pressure in the drill and, incidentally, the valve in the chuck. The same machine is used for tightening the packing nuts, only in that case a smaller and speedier drill is employed and the reducing valve is set at 20 pounds pressure.

Tightening valve bonnets in the plant of the Detroit Lubricator Company by the use of an Ingersoll-Rand air drill mounted in machinery especially provided for the purpose.

Oil Engine in South American Coffee Plant Effects Large Savings

By J. H. ROEBUCK

EVERY discriminating coffee drinker considers the brew made from the bean of the *cafetale* either good or bad—there is for him no middle ground. And many a hostess who prides herself on the excellence of her table has lost her reputation by serving an indifferent cup of "mocha" after an otherwise perfect repast. Yet very few of us know why some coffee pleases the palate and some does not, nor do we trouble ourselves to find out from what part of the globe comes the coffee that suits us and what happens between the time it is picked and sent to market.

Brazil, as most of us know, is the largest coffee-growing country in the world. There the berries or beans are allowed to remain on the trees long after they have ripened, when they are shaken down and harvested. In the Republic of Salvador and in other parts of Central America it is the practice to gather the crop when ripe and to put it through a *beneficio*, so called because the processes involved benefit the product, thus giving it a higher market value.

Foremost among the coffee planters in Salvador, is the Alvarez family. It was Dr. Emilio Alvarez who built the first *beneficio* in the republic more than 50 years ago. From the days of this modest mill down to the largest of the modern *beneficios* now in use in Central America and owned and operated by Rafael Alvarez & Sons, the industry has undergone great development; and it is with this development, due largely to the foresight and efforts of the Alvarez, that this article deals. The burden of the present business under that name falls on the three sons, Carlos, Jorge, and Samuel.

The west coast of Central America is well suited to the raising of coffee because of its pronounced wet and dry seasons and because of its mountain ranges. Coffee cannot be grown successfully at elevations below 2,000 feet or above 6,000 feet—that produced anywhere from 3,000 to 4,000 feet above sea level generally being considered best. An exception to this is the brand called *Malacara*, meaning ugly face, which thrives at an altitude slightly in excess of 4,000 feet and brings a higher price than the other Alvarez coffees, of which *El Molino* is the principal one. Therefore the plantations are to be found on the slopes of mountains which, in the case of Salvador, are mostly extinct volcanoes.

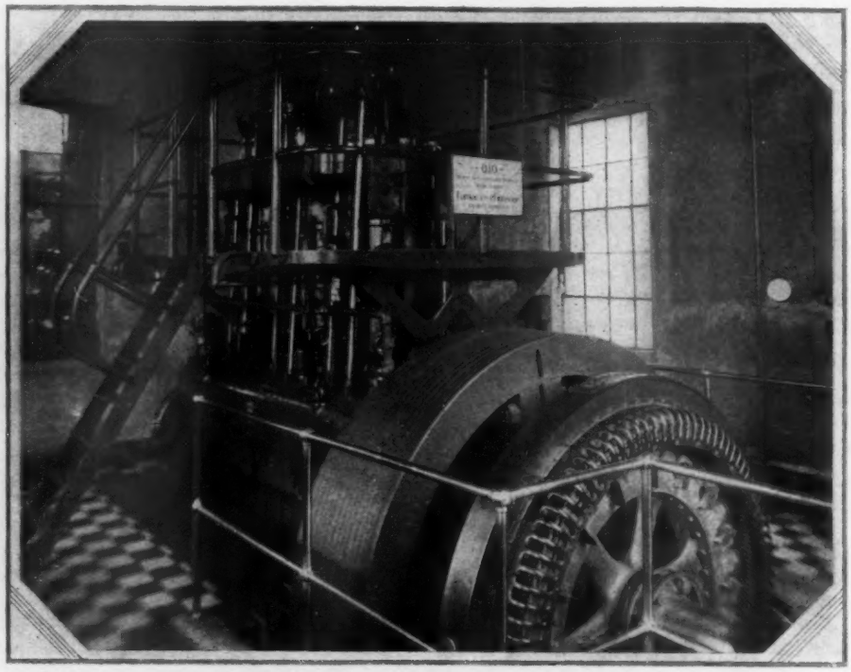
The trees are known to yield more and better coffee if they do not receive too much sun. Thus it became customary to plant shade trees among them. For this purpose a member of the Alvarez family introduced the *pisquen*, a tree with a sensitive leaf which closes when anything comes in contact with it. This freak of nature is taken advantage of for the benefit of the plant sheltered by it during the daytime. At night, the falling dew causes the leaves to close, thus enabling the moisture to reach the *cafetales*.

The Alvarez were also the first to terrace the mountainsides so as to facilitate the work of cultivating the plantations. To prevent the earth from being washed away during the wet season, when as much as 2 inches of rain may fall per hour, rows of *yuccas* are grown along the edges of the terraces. This plant has a very fibrous root which serves to hold the ground in place. Besides, the company is planning to use the fibrous leaf of the *yucca* in the making of sacks for its coffee.

Up to four years ago, the harvest was hauled to the firm's *beneficio* in ox carts, which necessitated the pasturing of more than 1,000 oxen on 260 acres of land. But all this is different now. The coffee is brought in by a fleet of twelve trucks, including eight 5-ton Macks, and the erstwhile pasture land is covered with a growth of young trees bearing their first crop this season. But before this change could be effected an extensive system of roadways had to be built to link up the far-flung plantations aggregating more than 3,700 acres. Where it used to be an all-day task to go over the ground on horseback, it is now possible to cover it in a few hours by automobile.

Ox carts were formerly used to haul the harvested coffee beans from the plantations to the receiving stations. Now this work is done by a fleet of motor trucks.

Coffee starts to ripen in the lower altitudes around the first of November, when cutting commences and continues for about six months. When ripe, the berry resembles a cranberry in color and shape but is slightly larger, and each contains two coffee beans. After gathering, the crop goes to the mill, where the pulp is removed and the beans are thoroughly washed. Carried along by flowing water, the beans next pass through canals to fermenting tanks where they remain for 24 hours. This process loosens the thin skinlike hull, which can then be easily disposed of during the drying process.



This Ingersoll-Rand oil engine of 330 hp. is the show feature of the Alvarez power plant. It drives a 240-volt generator which supplies current to operate the different motors installed in the beneficio.

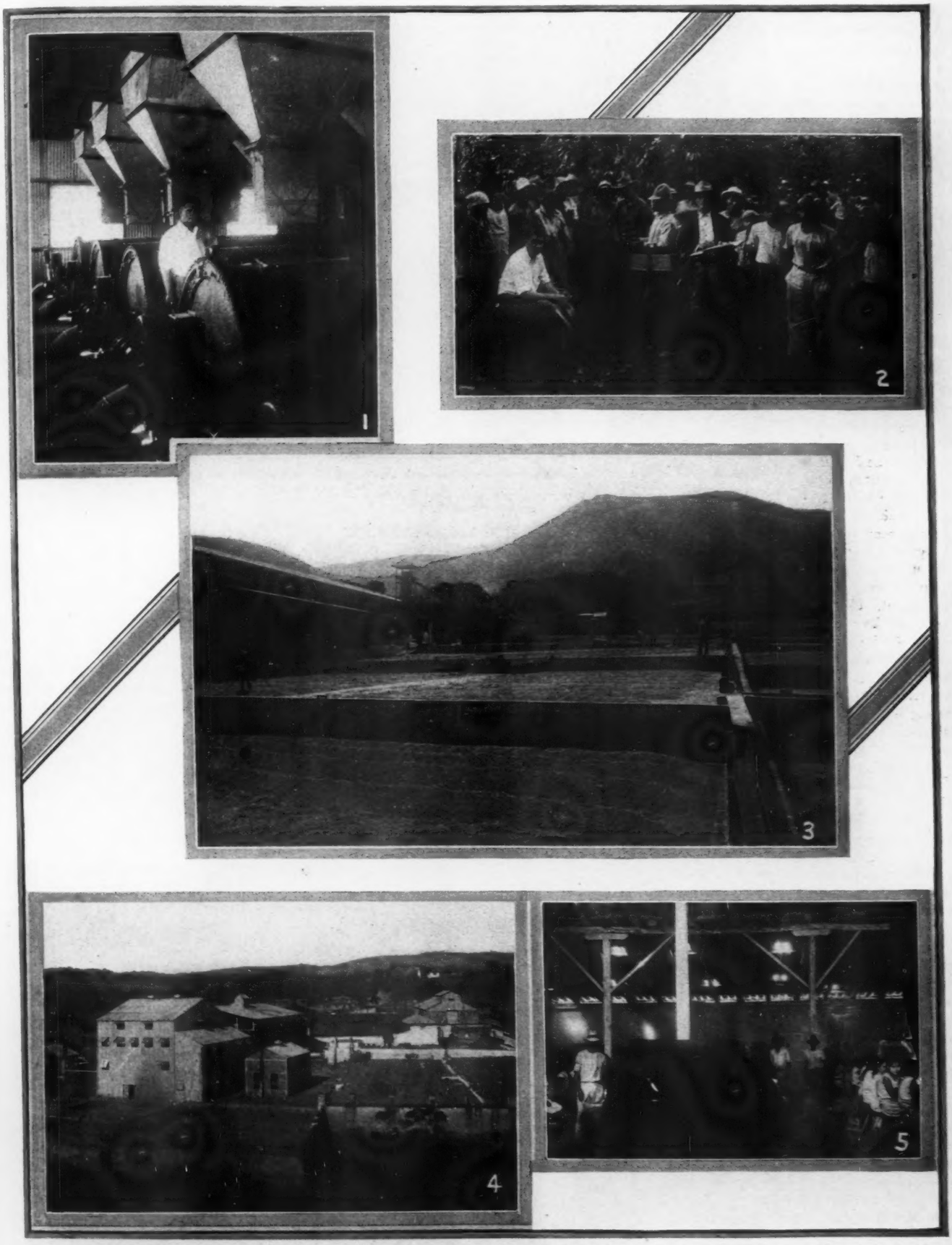
Until recently, the coffee at the company's plant was sun dried on the brick floors of large *patios*. This involved the transfer of the contents of the fermenting tanks to these exposed spaces, which was effected by means of centrifugal pumps—the coffee being delivered to the suction end of the pumps by water. During this curing process, which took anywhere from twelve to fifteen days, the coffee had to be raked continually to insure uniform drying; and, each evening, it had to be swept into piles and covered with canvas to prevent the dew from wetting it. With the curing finished, the coffee had to be packed into sacks and returned to the *beneficio* for further handling before shipment.

To save both time and labor, the company has acquired during the past year a coffee-drying plant with a capacity of 50,000 pounds in 24 hours. The building is three stories high and of all-steel construction. There the curing is done in ten perforated metal cylinders, each 6 feet in diameter and 16 feet long. Each drier holds 10,000 pounds of coffee, and is rotated slowly by a 3-hp. motor. Blower air, at a temperature of 165° F., is passed through the coffee. The centrifugal blowers provided for this purpose draw the air over a bank of steam coils and deliver it at both ends of the driers, each of which has its own blower. But before entering the perforated cylinders the coffee is freed of its surface water in centrifugal driers, which are similar to those used in sugar mills for extracting the sugar from the syrup. Each charge is left in its centrifugal for but ten minutes, and the amount of moisture removed in that short period is equal to the drying effected by from three to four days' exposure to the rays of the sun. There are ten of these centrifugals in the drying plant, and their combined capacities is sufficient to supply the cylindrical driers. The centrifugals are belt driven through clutch pulleys from a line shaft, and the prime mover is a 60-hp. Ingersoll-Rand FP steam engine. The exhaust from this engine is utilized for heating the steam coils of the driers at 10 pounds back pressure; and the fuel for its boiler consists entirely of the thin hulls from the coffee beans. These serve the purpose admirably, because they contain a considerable quantity of alcohol.

Under present conditions, the coffee is pumped from the fermenting tanks directly to the bins supplying the centrifugals in the new plant; next, by the assistance of various conveyors, it passes through the driers; and, finally, reaches the machines that rid the beans of the hulls. From start to finish, the drying process takes about 40 hours. With that part of the work done the coffee goes to the classifiers, which sort it according to size and grade. Before shipping, however, it is once more sorted by hand, some 300 women being employed for this purpose day in and day out while the coffee season is in progress. During a season, Rafael Alvarez & Sons handle upwards of 3,500 tons of coffee, more than half of which grows on their own plantations—the remainder being purchased.

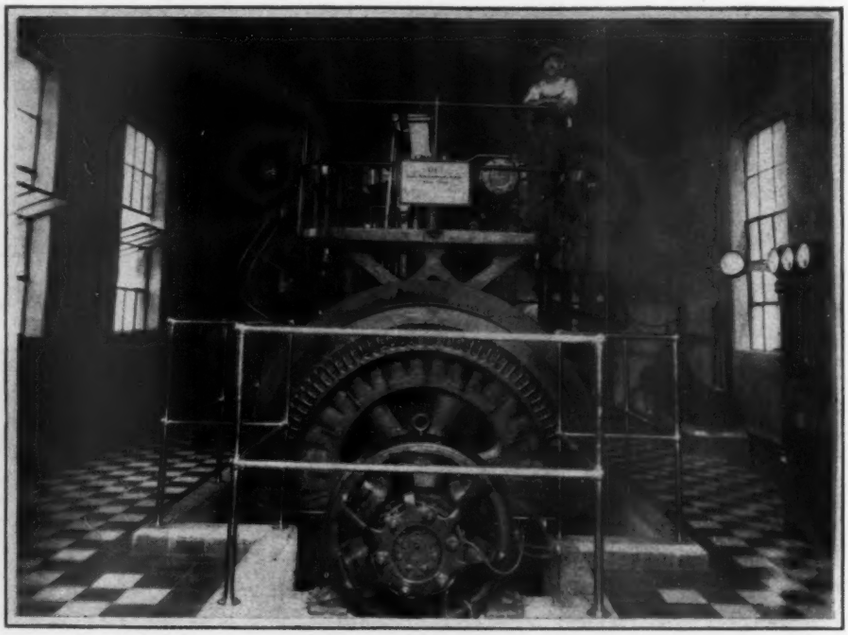
Another improvement that has done much to speed up operations is the new power

Left—A nursery for the propagation of young coffee trees. Right—Coffee trees yield more and better coffee when partly shaded from the sun by other trees, as here shown.



1—Five of the cylindrical coffee driers in the Alvarez mill. 2—Receiving coffee from pickers at one of the plantations. 3—Coffee drying in the sun on the brick floor of large patios. This was the procedure before the rotary driers were installed. 4—General view of the Alvarez beneficio and the new power plant. 5—Before it is shipped, the coffee is hand-cleaned at the beneficio by girls and women skilled in the work.

plant, which has been made a real show feature of the place. The structure is a sturdy one of reinforced-concrete and brick so as to withstand the earthquakes that occur not infrequently in that region. The inner walls are white; the floor is of black-and-white tile; and all railings in the engine room are of highly polished brass. This plant houses a 3-cylinder 330-hp. Ingersoll-Rand oil engine, which is direct connected to a 240-volt, 3-phase, alternating-current generator with a direct-connected exciter. This unit supplies current to the various driving motors throughout the *beneficio*. Since it was put in operation at the end of November, 1928, the power plant has been running continuously except for a regular 3-hour inspection every six weeks.



Close-up of the 240-volt alternating-current generator direct connected to an Ingersoll-Rand oil engine. This power plant has been running steadily since November, 1928, and has been halted only every six weeks for a 3-hour inspection.

The oil engine has an average load of about 200 hp., which is distributed as follows: drying plant, 142 hp.; pulp-removing machinery, 30 hp.; hull removers and coffee polishers, 40 hp.; classifiers, 20 hp.; hull-removing machines used when coffee is dried in the pulp, 40 hp.—in all 272 hp. The balance of the available power is to be utilized for operating long belt conveyors that are to be installed next season for the purpose of speeding up the hand-sorting of the coffee. At present it is impossible to get all the help necessary for this work, and therefore an effort is being made to provide facilities that will increase the output per woman. The aim of the company is to ship from the mill each day the same amount of coffee received there.

From the day the oil-engine-driven generator was put in service, accurate records have been kept of the consumption of fuel and lubricating oil; and these show an operating cost, in United States currency, of $0.0105 per kilowatt-hour as shown by meter, and including labor. The cost at the plant for fuel oil is $0.11 a gallon and for lubricating oil $2 a gallon. The pay of the operators is $5 per period of 24 hours.

Upon the strength of the performance of the first oil engine, another unit of the same size and type is shortly to be installed, and some of the power so developed is to be utilized in providing cheap fertilizer for the coffee plantations. The plan is to build close to the *beneficio* a plant for the grinding of certain local sands which contain chemicals that are good for the soil. These sands are found in abundance at the nearby seashore.

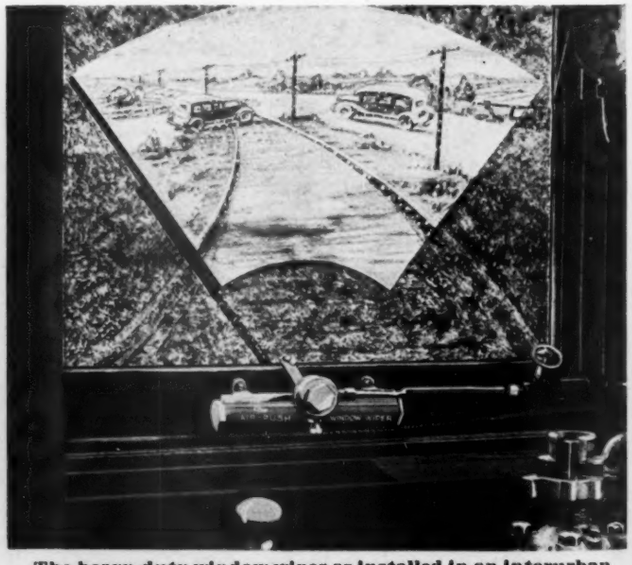
Germany is now producing annually around 50,000 tons of synthetic gasoline from brown coal or lignite.

HEAVY-DUTY AIR-OPERATED WINDOW WIPER

THE light-weight windshield wiper is no novelty, as there is hardly a passenger car today that is not equipped with a device of this kind that gives the driver an unobstructed view ahead when snow, sleet, rain, or misty weather otherwise would obscure his vision. Its importance need not be stressed here, as every autoist is fully aware of it. Now comes along a heavy-duty window wiper that does for the bus and truck driver, for the motorman of a street car or an elevated train, and for the railroad engineer what its smaller relative has long been doing for the motorist.

The "Air-Push" window wiper is the product of The Hays Corporation, and, as its name implies, is operated with compressed air generally available in the vehicles just referred to for braking purposes, opening doors, and the like. It is of necessity of sturdy construction; and the main body is of heavy, machined bronze that will not rust. The wiper arm, which varies in length from 12 to 20 inches to suit different-sized windows, can be adjusted to either a 70° or a 90° sweep; and the speed of its accurately timed movement can be controlled by a needle valve within convenient reach of the operator. Compressed air at a pressure of 25 pounds per square inch may suffice to swing the blade back and forth across the glass surface for ordinary service; but, as a pressure up to 200 pounds will do no harm to the mechanism, it can be counted upon to do its work even under the most trying conditions.

In reporting on a continuous test-run, the Chicago South Shore & South Bend Railroad—which is now using "Air-Push" wipers—has stated: "They are very accessible to repairs and replacements and apparently have a long life, as the 553 hours of continuous operation is equal to about seven years of normal car operation. Being driven by compressed air, they have power enough to remove almost any accumulation on the glass."



The heavy-duty window wiper as installed in an interurban electric car.

The new alloy steel "Izett", used in the boilers of the North German Lloyd liner *Bremen*, is to be manufactured in the United States under Krupp patents by the Central Alloy Steel Corporation, Massillon, Ohio. Izett stands for *immer zaehe*, always tough; and leading metallurgists, so it is reported, consider the metal an important step forward in the art of steel-making. The prinicpal claims made for Izett are: it does not become brittle when cold-worked; prevents the formation of cracks especially at rivet holes and heads: and it does not lose its tensile strength through use. Its special field of service is in the construction of boilers and steam-generating equipment.

Pneumatic Tubes May Link Airports and City Post Offices

By HAMILTON M. WRIGHT

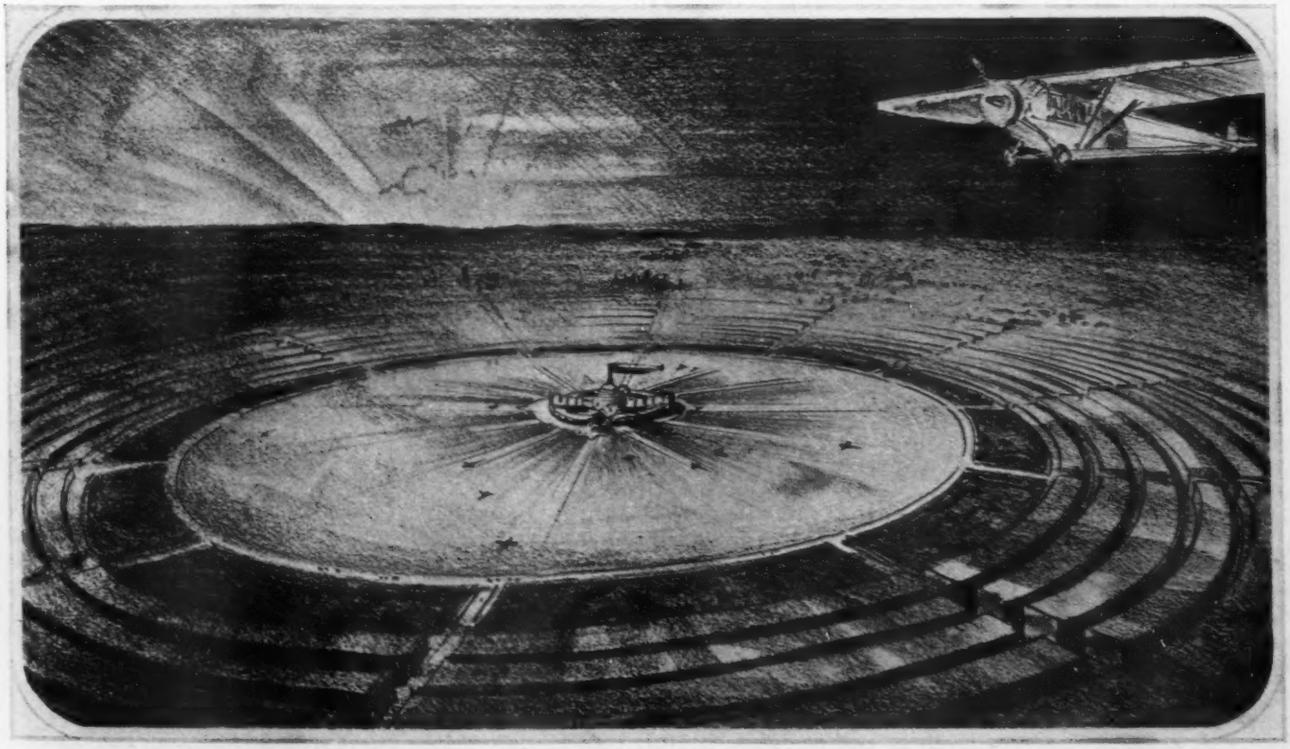
SPEEDING the transportation of postal matter by means of aircraft has become a recognized system both in this country and abroad; and it is undeniably true that many hours can be saved in this way especially when the distances are long between points of departure and points of alighting. But, unfortunately, these gains are often seriously offset by the delays incurred in moving the mail from airports to centers of postal distribution.

The foregoing handicap to expedition is due in the main to the need of locating airports on the outskirts of cities where expansive areas of suitable ground can be obtained at a reasonable outlay. This state of affairs will probably continue until aircraft are devised that can ascend and descend nearly vertically when taking off and when landing. In the meanwhile, facilities must be provided that will make it practicable to use existing and future airports more or less similarly situated. To do this effectually, and to save time now lost by motor transport or other present means of moving postal matter from field to city or vice versa, some form of really rapid transit must be installed that will shoot the mail from the urban center to the airport and from the airport to the main post office. The solution of the problem lies in adapting pneumatic mail tubes for this service—in other words, extending the scope of their employment. In this way, much of the time now lost between airports and city post offices can be saved despite hampering weather, bad out-lying roads, and congested urban thoroughfares.

Pneumatic-tube service has been established for more than 40 years in Berlin where the rapidity with which a letter goes from one side to another of so large a city is the amazement of visitors. In Paris the *pneumatique*, shooting its special-delivery mail at high speed underground, is known to everyone. The system employed is polygonal, like that of Berlin and Vienna, in which stations are grouped on circular or looped lines around which their carriers travel in one direction only. In London the radial system is used—all the tubes connecting the main post office with the substations. A development of this principle obtains in New York, where the containers, which are forced through the mail tubes by swiftly moving columns of air, average more than 140,000 carrier-miles per day—equal to a daily service of 5⅔ times around the world.

Little is generally known of this method of dispatching mail matter between the main post offices and their substations. In the case of the New York system, the metal carriers which are shot through the tubes are each 24 inches long and 7 inches in inside diameter. They are embraced, exteriorly, by "riding rings" having an outside diameter of 8 inches. These rings prevent direct contact of the carrier with the inside of the tube, which is 8⅛ inches in diameter, inside measurement. Each container weighs about 20 pounds unloaded, or 30 pounds loaded, and holds anywhere from 500 to 600 letters.

The carriers are shot through the tubes at a maximum speed of approximately 30 miles an hour by a column of air supplied at relay stations and by electrically driven fans or blowers in the basement of each post office. The air exerts a pressure of about 5 pounds against the rear ends of the containers; and in driving them through the south- and north-bound tubes—in reality one continuous tube—the air makes a complete and continually moving circuit. Thus the air under pressure, being valuable, is most carefully conserved. Little of it escapes when a carrier filled with mail is shot on to a table in the particular post office to which it is consigned. On leaving the main tube to ascend into the post office, the container opens a valve which closes after it, while its momentum carries it on toward a final valve which opens under



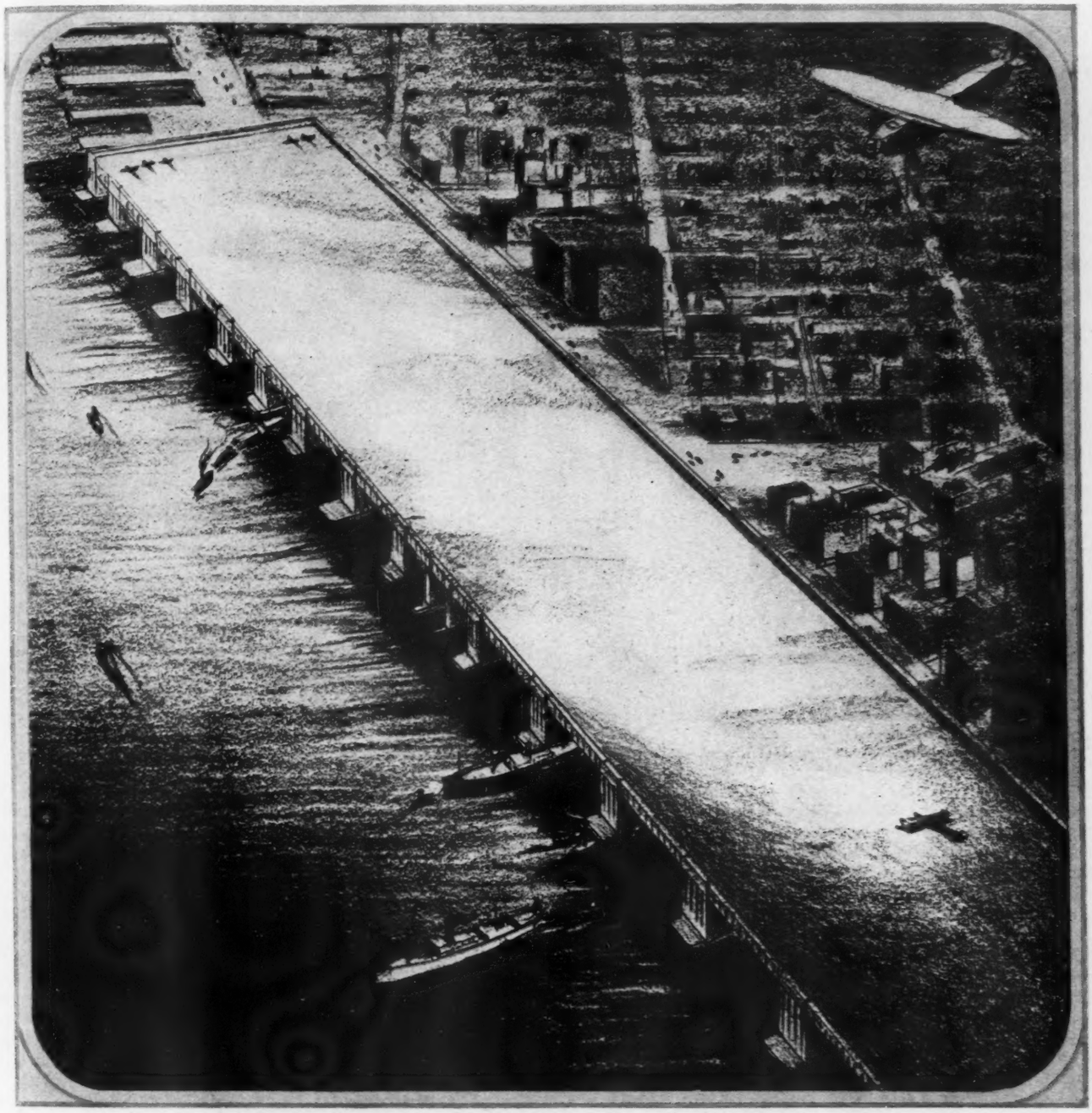
As cities may be planned for the future use of aircraft. The landing field would have a diameter of 7,500 feet, and mail matter would be distributed from this central point through radiating pneumatic tubes extending into the enveloping community. Such, at least, is the conception of Mr. Francis Keally, a well-known airport architect.

Gigantic hangars at D'Orly, France. A sketch from life by Francis Keally.

the impulse of a current of air induced by the speeding container, itself. The air so compressed also serves as a cushion and lowers the velocity of the carrier, which, after it has passed the last valve, strikes a buffer on the metal table and is picked up unlocked and emptied of its contents. Newly filled containers, or loaded ones which have arrived for relaying to another station, are placed in a metal groove which connects with the table. Their departure is regulated by an electric timing device that makes it possible to dispatch a carrier every six seconds. However, as a rule, they leave the office at intervals of from eight to ten seconds.

The methods employed in the European cities do not differ greatly from those in New York, though the sizes of tubes and containers vary—some of the tubes used in Berlin being only 3 inches in diameter. Therefore a description of the operation of one will suffice for all. The important point is that the service is uninterrupted by heavy snowfalls, by traffic jams, or by armed bandits in motor cars. In New York the operation of the pneumatic-tube system has reached a remarkably high stage of efficiency, as indicated by the following percentages of perfect service for some years past: 1922, 98.8033; 1923, 99.9101; 1924, 99.9141; 1925, 99.9725; 1926, 99.9597; 1927, 99.9726; 1928, 99.9661. Interpreting the last figure, it may be said that the 1928 service was just one twenty-fifth of 1 per cent short of perfect operation.

The saving of time in the arrival of mail at its destined post office is one of the outstanding advantages of the system because local letters can then be handled by carriers starting at an earlier hour on their routes through the buildings and outgoing mail can reach trains departing earlier. It requires but four minutes for letters to pass between Manhattan and the main Brooklyn post office, while mail dropped in uptown New York in the morning does not arrive at the Park Row or Wall Street stations downtown until two or three o'clock that afternoon. In the case of letters addressed to distant parts of the country,



An airplane landing field above the steamship piers on the North River waterfront of New York City, as conceived by Mr. Keally.

the use of the pneumatic tube may mean a gain of 24 hours in their ultimate delivery.

The great contrast between the effort to annihilate time and space by long-distance flights in the transportation of mail and the possibility of delays in its delivery in the city after its arrival at the nearby terminal airport has long been noted by officials. Elevated landing platforms built close to the business and financial centers and above unobstructed waterfront streets, piers, or railway tracks have been suggested by such architects as Maurice Chauchon of Paris and Julian Clarence Levi of New York. These platforms, constructed on the unit plan, would permit small planes to bring in passengers and air mail from outlying airports in from five to fifteen minutes. Passengers could then immediately jump into waiting taxicabs, while the mail would be shot through pneumatic tubes directly into the post offices.

Turning briefly to the history of the pneumatic transmission of mails, we find that the first idea of this sort appears to have been conceived by Denis Papin who, in 1667, presented a paper to the Royal Society of London on the *Double Pneumatic Pump*. This consisted of two large cylinders to exhaust the air from a long metal tube containing a traveling piston, to which a carriage was attached by means of a cord. The idea languished for more than 100 years. The sending of written dispatches through long, narrow tubes by the agency of air pressure was first practically introduced in England in 1854 by Mr. Josiah Latimer Clark—the system then installed operating a distance of about 700 feet between the stock exchange and the main office of the Electric International Telegraph Company of London. Carriers containing batches of telegrams were sucked through the tube, in one direction only, by the production of a partial vacuum at one end by a steam pump. This was later supplanted by steam-driven air pumps which have, in turn, been succeeded by the modern high-speed electrically driven fan or blower.

In closing we will turn to the future. Al-

This sketch illustrates how Mr. Keally would provide an airplane landing field in the heart of New York City over the tracks of the Pennsylvania Railroad. Arriving mail would be shot through pneumatic tubes to the nearby post office.

though sociologists and city planners earnestly hope for an alleviation of the conditions that make for congestion in cities, it is difficult at present to imagine that the economic forces responsible for the dense concentration of the populace at certain points will change their direction. Mechanical power will continue to lighten the labor of the farm, while industry will continue to attract people to the cities. Leading business and financial interests, corporations, etc., will want headquarters in London, Paris, Berlin, New York, and other centers which are close to the headquarters of similar enterprises. Although the congestion in New York City is often laid at the door of the skyscraper—and, indeed, it is said that the inhabitants of the Metropolis will soon overtax its sewerage facilities, yet Paris and London, possessing none, are responding to the economic trend towards concentration.

With the far greater congestion that may be expected in years to come, the speedy delivery of mail will assume increasing importance, and the pneumatic tube will fit into the scheme that is designed to remove all transport in cities. except that of persons, to underground levels. Undoubtedly, the vast skyscrapers which architects and construction experts predict for future New York will require their own branch post offices connected by pneumatic tubes with the main post-office stations. Methods may then be developed to send mail direct to the very offices of the great banks and corporations, for inter-building communication by the tube system is already well developed and all that is needed to accomplish that end is to make connection with the pneumatic post. The New York Stock Exchange, Marshall Field & Company, and other great enterprises use the tube in the dispatch of orders and important documents; and the United States Treasury in New York maintains its own service of more than two miles between the Appraisers Building and the Custom House.

Herbert Photos

Airport architects, aircraft pilots, and postal authorities examining the equipment for the pneumatic distribution of mail in one of New York City's postal stations. The pneumatic system of the Metropolis thus shoots letters an aggregate distance of 140,000 carrier-miles a day.

AIR-LINE LUBRICATOR OF NEW FORM

THE Ingersoll-Rand Company has recently announced the development of a new form of air-line lubricator that is well-nigh foolproof because it has no moving parts to be adjusted or to get out of order. It is known as the Type "D", and may be used in either pipe or hose lines serving rock drills of all sorts as well as the lighter-weight pneumatic tools designed to do a wide variety of work.

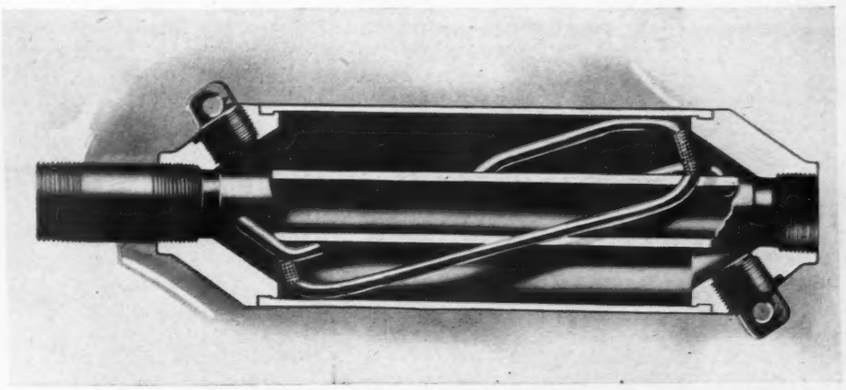
The new lubricator consists essentially of an outer tube or reservoir with a cap permanently attached to each end, and of a centrally disposed tube around which there is a still smaller tube with a strainer screen in each of its two loops, as shown in our illustration. The two ends of this tube enter the center tube at opposite ends and opposite sides, thus assuring the functioning of the lubricator no matter what may be its position. There are two filling holes, one in each cap, and these are in line and sealed with threaded plugs.

The oil in the reservoir is under pressure as soon as compressed air is applied to the lubricator; but the oil is not carried into the line until there is a flow of air through the center tube. From this tube, by reason of a slight drop in pressure between its ends, the air is forced into the smaller tube, and it is this air that picks up the lubricant and carries it through the circulatory system into the air line—the oil entering the system through the screened opening that happens to be submerged at the time.

The function of the Type "D" lubricator is assisted considerably, so it is said, by air pulsations due to the intermittent action of pneumatic tools. These pulsations tend to increase the turbulence set up within the center tube, to just that extent stimulating the admixture of the confined air and oil and helping to bring about more complete atomization even of lubricants that are admittedly difficult to break up. This breaking-up action begins in the reservoir, itself, where the compressed air bubbles through the mass and the oil surges through the screened opening.

Because of the principle on which it operates, the lubricator is virtually drained of its entire charge before there is need of refilling it. Should it require cleaning, this is effected easily by washing out the reservoir with kerosene and by removing any foreign matter, such as dirt, etc., by a blast of compressed air. The Type "D" air-line lubricator is furnished in pint and quart sizes 8 and 12 inches long, respectively.

The resistance of buildings of all sorts to earthquakes is being made the subject of special study at the Stanford University, Palo Alto, Calif., by means of a specially built shaking table on which model structures are subjected to vibrations and shocks simulating those induced by the natural phenomenon.

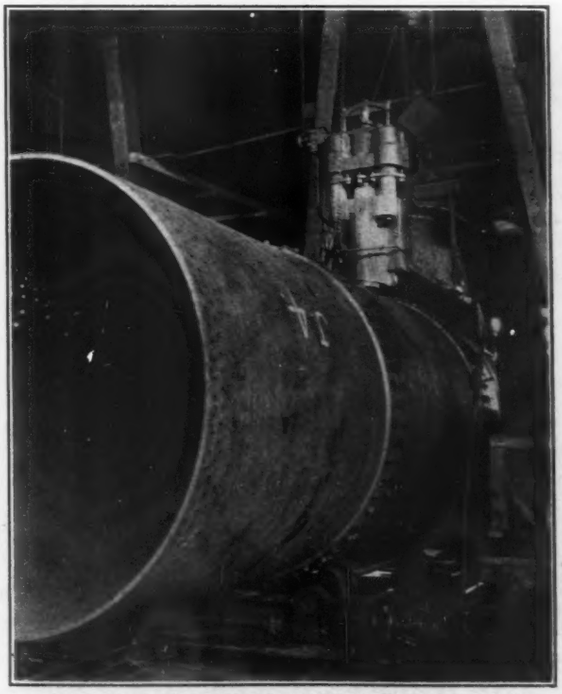


Longitudinal section of the new Ingersoll-Rand Type "D" air-line lubricator.

NEW METAL WITHSTANDS GREAT HEAT

THE research laboratories of the Westinghouse Electric & Manufacturing Company have announced the discovery of a new metal which is said to be much stronger at high temperatures than other metals, thus making it especially suitable for the moving parts of internal-combustion engines and other machinery in which such parts are subjected to great heat.

"Konel" is the product of Dr. E. F. Lowry, and was originally developed as a substitute for platinum in the manufacture of filaments for radio tubes. In this field, alone, it is already effecting a saving of approximately $250,000 monthly because of its comparatively low cost. Engineers, however, predict many uses for Konel, which is harder to forge than steel and is very tough at temperatures at which most metals lose their strength.



One of the air-operated "Utility" hoists used in the South San Francisco plant of the Western Pipe & Steel Company to rotate pipe lengths during rivet driving.

RIVETING PIPE LENGTHS BY AID OF AIR HOIST

A SPECIAL and somewhat unusual application of the air hoist is reported from the South San Francisco plant of the Western Pipe & Steel Company. The plant in question is one of the largest steel and plate fabricating shops on the Pacific Coast and produces much of the piping utilized throughout California in the construction of penstocks and pipe lines. At the time of writing, the shop was turning out material for the penstocks of a large power project on Big Creek. The 8-foot-diameter pipe sections on this job are held together by butt straps and four rows of 1⅛-inch rivets at each joint; and it was in this work of riveting that the air hoist played a very helpful part.

The units to be joined were set on a little car, locally spoken of as the "round seam car", which is moved along the rail by a hand ratchet. Thus mounted, the rivets were driven, the pipe the while being turned as desired by the air-operated hoist. To quickly adapt it for the purpose without in any way destroying the usefulness of the hoist in other directions, a driving gear was bolted to the face of the drum. This gear meshes with a gear on a shaft which transmits the motion through a special worm reduction gear. This arrangement makes for easy control and assures sufficient power to rotate the heavy piping. This system of handling large pipe sections during riveting is now in common practice in the South San Francisco shops, where from three to four "Utility" hoists are generally required for this service.

New processes of recovering manganese from certain low-grade ores in the United States were described at the second annual convention of the American Manganese Producers' Association, held in Washington, D. C., as "practical as well as sound in principle." If that be true, then there is a likelihood of our becoming independent of foreign sources of supply, as millions of tons of the ore are known to be available in Montana.

Treasure Hunting in Bolivia

Some Side Lights on Sacambaya Exploration Company's Quest for Gold Buried a Century and a Half Ago

By J. R. SHOTTON

JUST a year ago—in November of 1928—this Magazine gave a detailed account of the initial work done by the Sacambaya Exploration Company, Ltd., in its search for the hidden treasure of the Jesuits expelled from upper Peru, now Bolivia, under pressure of the Spanish Crown back in 1778. The activities then described, including the arduous transport of the equipment to the chosen site, covered a period of nearly five months; and it is now the purpose to tell what happened between the middle of August and November when the rains set in and operations had to cease for the time being.

The main point of attack of the treasure hunters, it will be recalled, was a huge stone structure in the region where the Khato and the Ayopaya rivers meet and form the Sacambaya. It is there the missionaries who followed in the wake of Pizarro and his conquistadores settled and found the gold which, eventually, was the cause of their deportation and which has stirred the imagination of the venturesome ever since. In the meantime, numerous expeditions have gone in quest of the treasure left behind by the fleeing priests; but so far it has eluded all the searches.

The question has frequently been asked: Why did the present expedition choose the "Square Stone Heap"—as the structure was named by Dr. Edgar Sanders, the leader of the enterprise—for the point of attack? This I will now explain; but, for obvious reasons, I must withhold the name of the individual who directed our attention to the spot. For the sake of convenience, he will be referred to in this article as Mr. London.

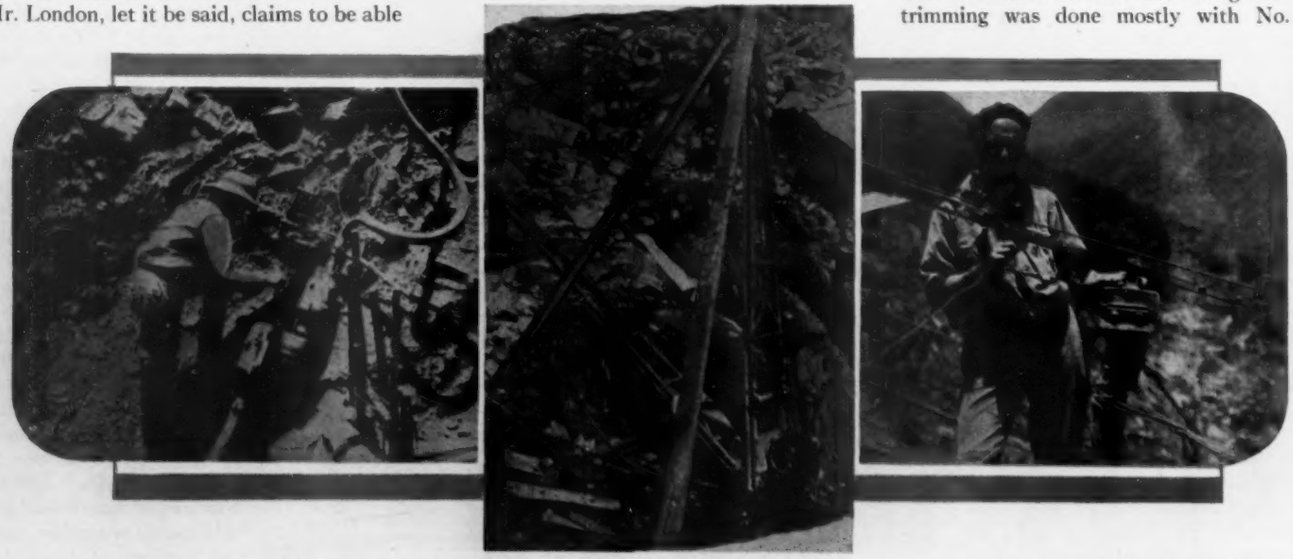
Mr. London, let it be said, claims to be able to detect metals and also to differentiate between metals by the traces left by their emanations, and which are visible on photographs. He has proved this many times over by thus reading aright aerial photographs taken from heights that make the ground appear comparatively flat. Before the expedition left England, in January of 1928, he was consulted and asked to examine photographs taken of the Sacambaya district two years previously. The negatives were old, and the photographs were taken from a horizontal not a vertical position, as required by him. Nevertheless, he marked a place on one of the prints, as shown at A in the accompanying diagram; and there, in a hillside, a horizontal cut was accordingly made about 36 feet wide so as to allow a margin laterally of approximately 16 feet on each side of the indicated point for possible error.

At Mr. London's suggestion we included among our equipment camera-carrying kites. By means of these he said we could take the right kind of pictures that would enable him to pick out the tell-tale traces of underlying metal with a greater degree of accuracy. Unfortunately, the kites were of no avail. Their use had to be abandoned, after a month of futile efforts, because of the gusty nature of the winds and the air pockets prevailing around the Sacambaya region. The idea of stretching a rope between convenient mountain tops did not occur to us until sometime afterwards, when we discovered that the aerial carrier would have to span a gap of substantially two miles. To provide this length of rope we not only had to clean out the entire stock at La Paz but had to go to Oruro, where we were able to obtain the remainder. In this way the desired bird's-eye views were taken and sent to Mr. London.

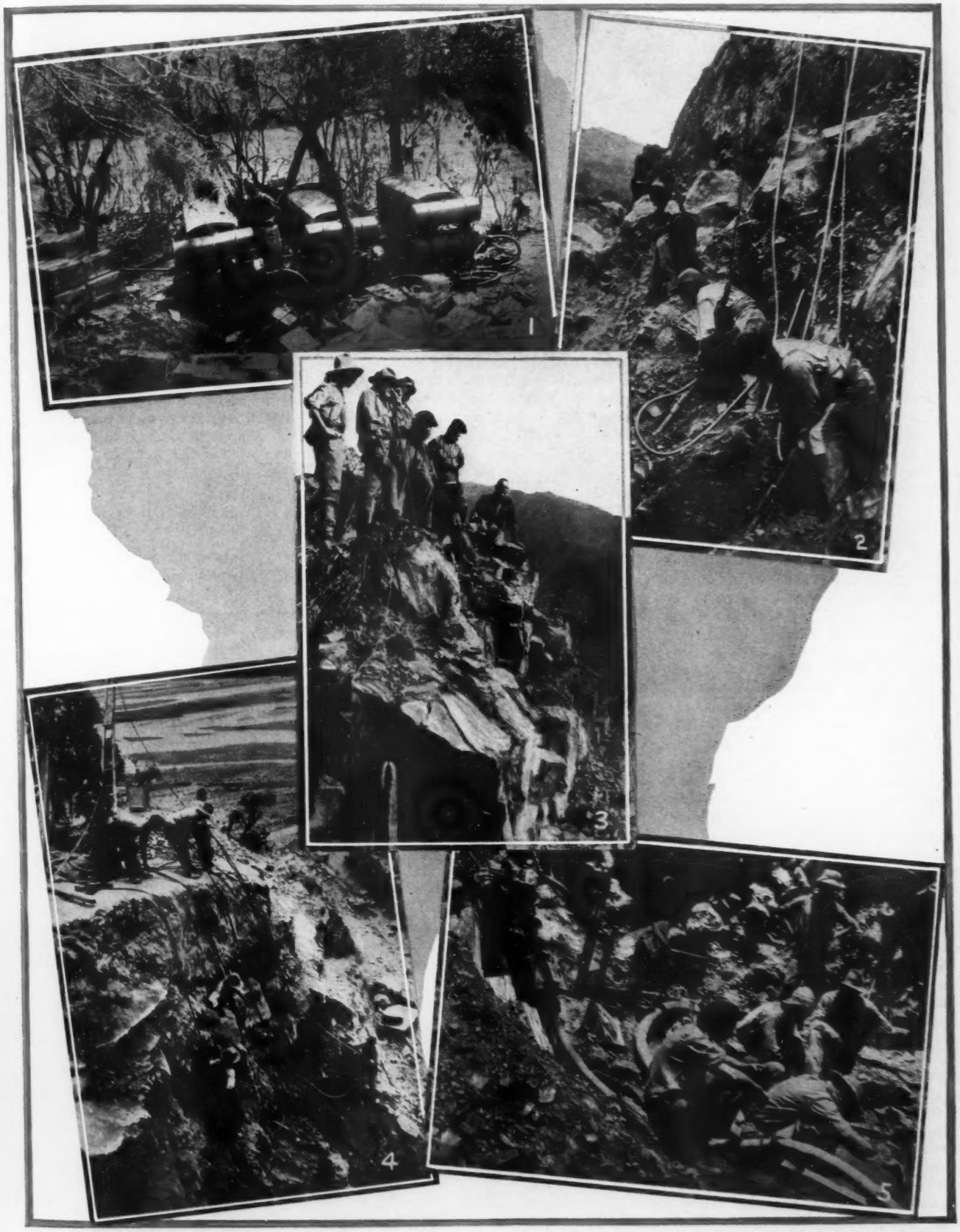
In the meantime it was decided to lower the floor of the cut about 16 feet and to advance the heading deeper into the hillside. When the aerial photographs were returned to us by Mr. London, we found that the horizontal indication of traces of metal coincided with that made by him originally, as at A in the sketch, and that it crossed his vertical indication at B—the two intersecting at O. Assuming then that the lines point in the general direction of the source of the emanations, you have our reason for proceeding with the work in the manner we did, and why we began digging a large open pit.

The excavating that followed was considerably slowed up throughout nearly all of September because of exceptionally heavy out-of-season rains. These not only prevented work from being done but they also loosened the surrounding wall, especially at the northern end of the pit where a large quantity of earth had to be removed to assure safety. Timbering or grouting was out of the question. The rains also brought in their wake hosts of insects that added to our physical discomfort, which was already trying enough.

By this time all the boulders in the main cut had been disposed of and only occasional block-holing was necessary when certain menacing boulders in the sides had to be got rid of. The remainder of the excavating and side trimming was done mostly with No. 157



Left—Close-up of the air-driven Cameron pump that was used in an attempt to unwater the pit. Center—One of the "Utility" hoists operating a crane. Right—Section of the 2-mile aerial ropeway with its suspended camera by means of which the desired panoramic views were taken.



1—Three of the four portable compressors that worked unfalteringly throughout the 1928 season after they had undergone a long and wracking journey overland. 2—Pneumatic diggers were principally used in trimming the sides of the pit. 3—Members of the expedition looking down into the cut after some of the boulders had been removed. 4—Trimming the pit walls was a perilous job. 5—At the bottom of the pit, showing the two pumps at work. This picture was taken on October 24, the day the 1928 operations came to a halt.

Left—At one stage of the operations, showing the railway cut. Right—This picture of the pit was taken before the dam was built.

pneumatic diggers. During the third week in October water was encountered when working about 34 feet below the railway cut. The flow seemed to come from the south side. To shut it out, we built a small clay-core dam in the form of a horizontal arch about one-third of the way from the south side. This was held in place with tin supported by stakes.

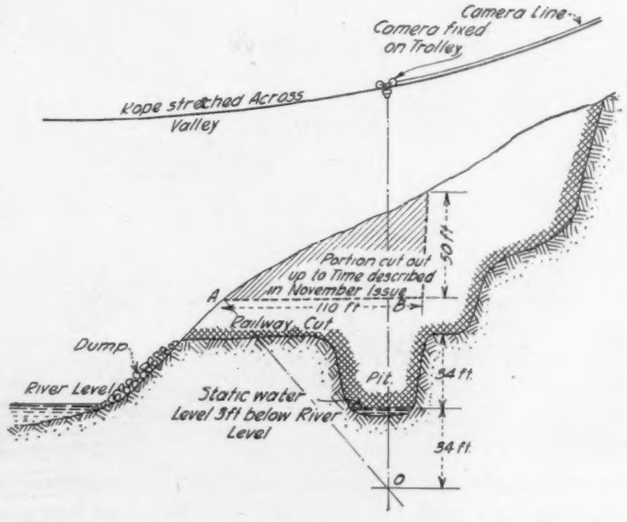
A Cameron vertical-plunger sinking pump, driven by compressed air, and a Gwynne 120-gallon trailer pump were next lowered into the pit. Soon after the Cameron pump was started, about 5 cubic yards of earth and stone fell on top of it. However, as soon as the noise subsided, we were heartened by the familiar chug-chug of the Cameron which showed that it was still pumping steadily.

When both units were put to work pumping water from the north side of the pit, at the rate of 150 gallons a minute, they were able to lower the level but 14 inches throughout an area of approximately 200 square feet. It took nearly four hours to accomplish this, and at the end of that time it was apparent that ground-water level had been reached, as water began to stream into the pit from all sides. This happened on October 24, and marked the end of the 1928 operations, as the wet season was approaching and we did not have the equipment necessary to cope with the situation. The static water level in the pit was about 3 feet below the river level.

Records and information obtained from old inhabitants of the district bear out the fact that the bed of the river has risen something like 100 feet in the last 150 years. Naturally, the ground-water level in the vicinity of the Square Stone Heap now also stands higher than it did formerly, giving warrant for the assumption that the chamber in which the treasure is believed to lie hidden is underwater.

The equipment used stood up to the test magnificently—the compressors and hoists deserving special mention. We had four 5½x5-inch Type Twenty portables and four "Utility" hoists, and their average working day was ten hours six days a week for five continuous months. Considering that these were operated either by inexperienced white men or natives under exceptionally severe and dirty conditions after a long rough-and-tumble journey overland, it is a noteworthy fact that in all that time it was not necessary to clean even a single engine plug. Apart from damage due to accidents—such as the overturning of a compressor during transport—or injury caused by flying fragments of rock after blasting, not a single item of repair was attributable to breakdown. It should be added that in the case of one of the compressors—probably the machine that was overturned—one of the lugs holding it to the frame was found cracked after three months of service. This, however, did not prevent it from plugging away steadily until the end.

The hoists did more than was expected of them. They handled every bit of the 14,000 cubic yards of material removed; and they put in a good day's work every day. In our opinion, they were very conservatively rated, as they exceeded their given lifting capacity by about 50 per cent with each load. Even at the end of operations they never refused this overload.



Cross section of the pit showing general arrangement of the ropeway and stages of the work halted a year ago.

There is the situation: the treasure, despite all our efforts, still remains hidden. The hope of locating it, however, has not been abandoned, and plans are now on foot to organize another expedition to go out next year suitably equipped to delve deeper in quest of the gold that has so long lured the venturesome.

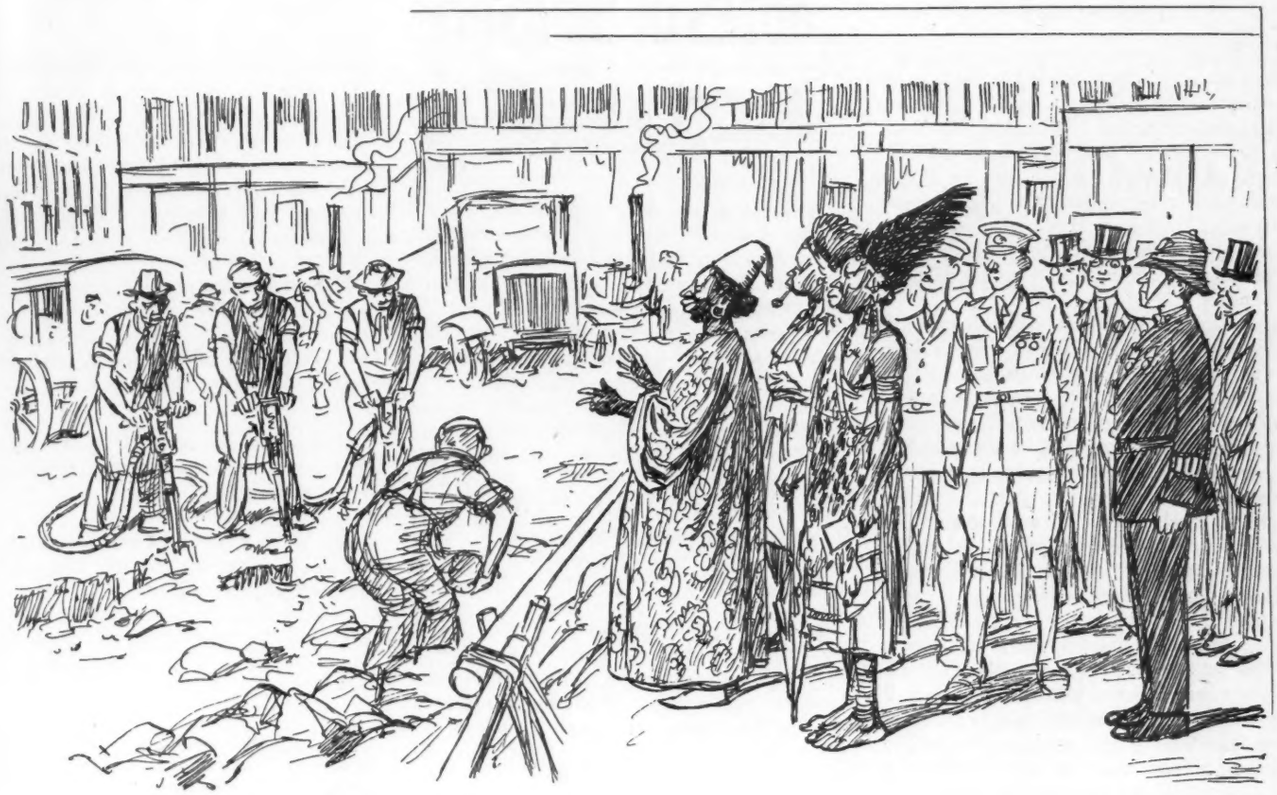
THE USEFUL CORN STALK

CORN stalk seems to possess so many valuable properties that it is hard to keep track of the diversified uses to which we are told it can be put. Its latest application, as brought out at the recent meeting in Minneapolis, Minn., of the American Chemical Society, is in the manufacture of gas for heating, lighting, and power, says Dr. A. M. Buswell, professor of sanitary chemistry at the University of Illinois and the man who made the discovery in coöperation with Mr. C. S. Boruff.

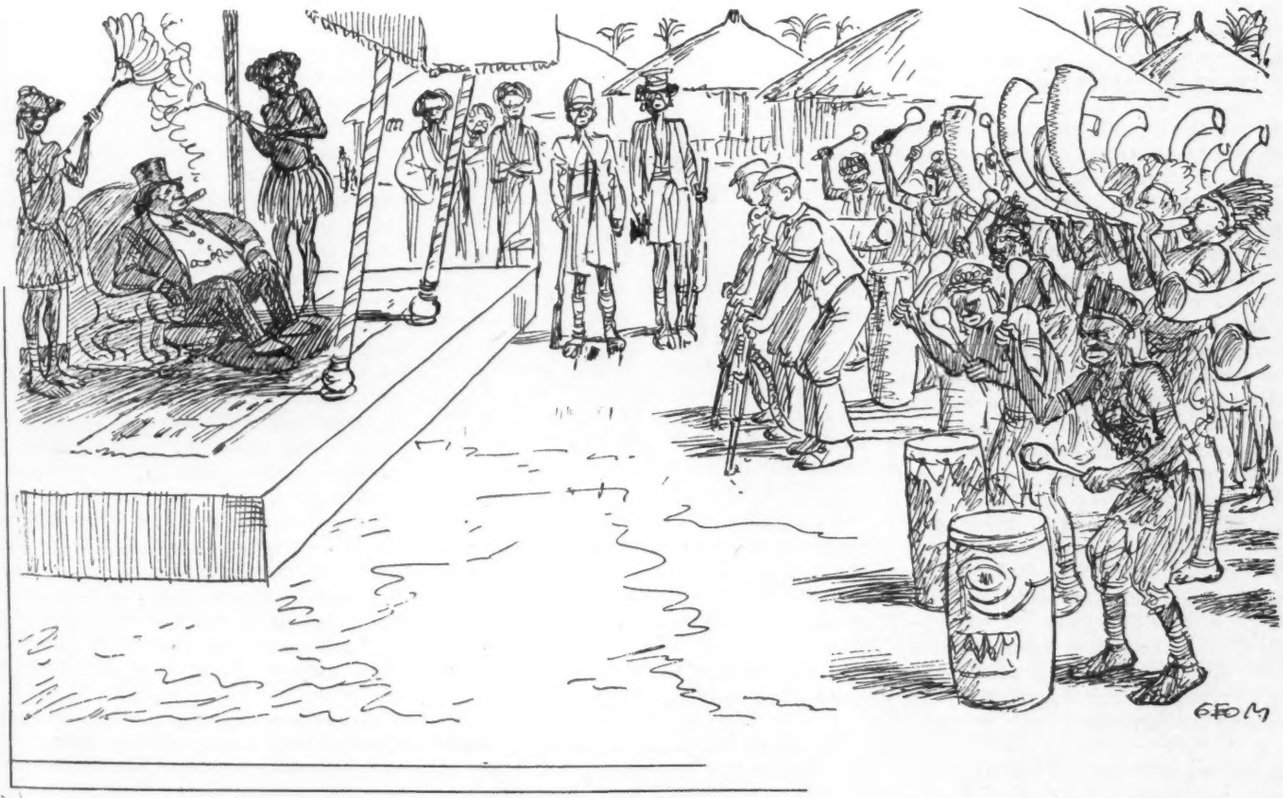
For this purpose the stalks are combined with ordinary sewage and converted into a gas by a process so simple that anyone can apply it. After husking, the stalks are dried, shredded, boiled, soaked in water or lime, and then, together with the sewage, put into a small tank that is provided with a cover to permit collecting the gases. There the mixture is allowed to ferment—the bacteria in the sewage doing the work.

To quote Doctor Buswell: "A farmer could thus produce enough gas to supply the needs of a family of four or five from the material which could be fermented in a gas tank 8 feet in diameter and 8 feet deep." It is estimated that a corn belt within a radius of four miles could provide enough of the raw product to meet the demand for gas of a city of 80,000 people.

The second of the three proposed trans-Pyrenean railways has been opened to traffic. It connects Ax-les Thermes, France, with Ripoll, Spain, and provides direct communication between Toulouse and Barcelona.



An African potentate on a visit to London is charmed with a new musical instrument—



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and on his return finds it very effective as an addition to his private orchestra.

INDUSTRIAL USE OF THE PERISCOPE

PERISCOPES, while primarily aids in warfare, also have their peacetime uses, as the following makes plain. In order to work a hill for sand and gravel, the Graham Brothers, Inc., have installed their Wilmington, Calif., plant on the side of the hill and not at the bottom, as is common practice in operations of this sort. Thus, instead of taking advantage of gravity and bringing the sand down to the plant, the material is excavated many feet beneath it.

At the bottom of the pit, which is now 100 feet below the plant, a power drag scraper conveys the material for a distance of 300 feet to a hopper, whence the sand is discharged through a grizzly to a bucket elevator and raised to the screening plant. There was just one drawback to this arrangement, and that was that the scraper-hoist operator could not get an unobstructed view of the pit because of the intervening hopper. By reason of the sloping plant site, the hopper was at a higher elevation than the hoist.

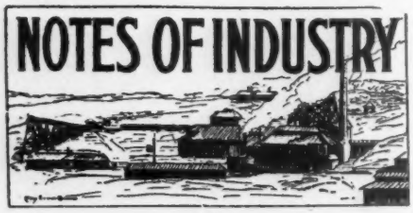
Instead of doing the usual thing under such circumstances and running the hoist from a platform by the aid of levers, the Graham Brothers conceived the idea of using a periscope—in this case a simple affair consisting of two mirrors. These are so mounted in relation to the pit and one another that the image caught in the one is reflected in the other in plain view of the operator. In this way he can stand alongside his hoist and yet watch the bucket as it travels back and forth between the pit and the hopper.

LUMINOUS WIND INDICATOR FOR NIGHT FLYING

THAT aviators in flight may know the direction of the wind over flying fields during the hours of darkness, a luminous weather vane has been invented that is said to be a marked improvement over the fluttering, indirectly lighted pennants now generally used for that purpose. It is a T-shaped affair, of metal, carried well up on a supporting framework in such a way as to prevent it from being whipped about. Green and red lights are best suited for the service, but red is preferable because of its fog-piercing characteristics.

Pilots have reported the luminous indicator visible on a clear night from a distance of eighteen miles, and during a fog they have been guided by it ¼ mile away. When at an altitude of 5,600 feet and ten miles distant they have had no difficulty in distinguishing the long member of the vane—which measures 15 feet—from the 7-foot crossarm. By thus giving aviators accurate and timely information as to the direction of the wind before reaching a flying field, their chances of making safe landings are proportionately increased.

X-ray moving pictures are the latest development in photography and promise to be of outstanding importance especially in the medical field.



It is reported that a promising nickel-copper discovery has been made in Canada in the vicinity of Ingolf on the Ontario-Manitoba border. The deposit is said to be an extensive one; and assays have shown the ore to contain 20 per cent copper, 1 per cent nickel, and about $3 worth of gold per ton.

What is said to be the world's largest tensile testing machine was installed not long ago in the plant of the John A. Roebling's Sons Company at Trenton, N. J. It is 42 feet high, 13 feet wide, and 21 feet long, and is capable of sustaining a maximum load of 900 tons. The machine is designed for the testing of wire cables of different sizes.

On the streets of London have recently appeared automobiles equipped with a safety feature in the shape of a compressed-air-operated mechanical arm terminating in a disk carrying an electric lamp. Instead of extending the hand when desiring to turn or to stop, as is now the fashion, the driver simply touches a convenient button on the steering wheel. This action simultaneously raises and lights the arm, thus enabling the motorist without effort to signal his intention to the car immediately behind.

Under the name of "Pin Nut", Kraberhall, Inc., of Philadelphia, Penn., have lately put out something new in the line of nuts. Its use is said to eliminate lock washers, cotter pins, jam nuts, and holes in bolts. Furthermore, the claim is made that it cannot be jarred loose or fall off, remaining where put on the bolt—either at full tension or in a position allowing for play—through the insertion of a pin as far as it will go in one of the slots provided for it.

According to figures recently compiled by the National Industrial Conference Board, the electrical industry of the United States served less than 4,000,000 customers in 1912 as compared with 23,000,000 in 1928.

A process of coating or waterproofing concrete with metal has been developed in Germany, where products so treated were exhibited not long ago. According to the inventor, he has succeeded in covering concrete slabs, tanks, pipes, and other forms of artificial stone with molten tin, zinc, or lead applied by the spray method.

The eighth National Exposition of Power and Mechanical Engineering will open at Grand Central Palace, New York City, on December 2, and continue throughout that week.

What is described as the most important silver-lead strike in Australia since that at Mount Isa has been made at Mountain Range, South Goulburn, in New South Wales. The mine has been named Mount Galena; and lodes 1,000 feet long and 500 feet wide have been traced from its base to its crest. Assays of ore taken from the caps of some of these lodes have returned, it is claimed, up to 46 per cent of lead and 8 ounces of silver to the ton.

The long-contemplated Golden Gate Bridge is to become a reality, according to news reports from San Francisco. The project will involve an expenditure of $30,000,000, including the cost of the approaches.

Approximately 24,000,000 tons of limestone are used in the United States annually in the metallurgical industry.

The output of pig iron and steel from American furnaces so far this year surpasses any previous record. During the first seven months 33,805,267 tons of ingots were cast, or 18.2 per cent more than the industry produced in the same period in 1928.

The scheme proposed in 1924 for tunneling the Lower Thames has again been taken under advisement by the British Ministry of Transport.

The Pennsylvania state authorities are considering the application of the Philadelphia & Reading Coal & Iron Company for charters for 33 electric-public-utility plants to be built at pit head in a corresponding number of communities.

A shipment of California fruit is to be sent around the world under the auspices of the University of California in an effort to determine under what temperatures the specific products can best be kept in first-class condition in transit afloat.

On the strength of experiments with non-skid pavements, the Highway Department of the State of Oregon has recently completed the surfacing of an aggregate of 101.5 miles of trunk roads for the protection of the motorist. The non-skid material consists of a mixture of asphalt and crushed rock or coarse gravel, and is spread three-fourths of an inch thick over the slippery asphaltic surface and the oiled shoulders, thus incidentally widening the highway for motor traffic. It is said that the comparatively rough surface does no more damage to the tires than the asphalt pavement but does offer them appreciably more resistance under all circumstances.

Figures compiled recently by the Department of Agriculture indicate that the per capita consumption of ice cream in the United States has nearly trebled since 1910. In 1928 the industry supplied 348,048,000 gallons, or 2.9 gallons per person.

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—Founded 1896—

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EDITORIALS

BINGHAM CANYON'S GREAT COPPER CAMP

IN the current issue we print the first installment of an article dealing with the inception and the development of the Utah Copper Company—a great enterprise that is providing the world with quite 8 per cent of all the copper utilized by it annually. We are authoritatively informed that this source of the red metal has produced in the course of the company's activity enough copper to form a wire as thick as the lead of a pencil and 74,000,000 miles long—more than enough to span the vast gap between Mars and this globe of ours.

Impressive as it is thus to refer to the more than 3,000,000,000 pounds of copper mined during the period of the Utah Copper Company's work in Bingham Canyon, still we must bear in mind the other astonishing fact that all this metal has been won at a profit from a deposit of notably low-grade ore. Monetary success is in large measure due to the engineering genius displayed in selecting the method of mining adopted. Instead of burrowing into the depths of the mountain, as would be the usual practice, the procedure employed is akin to quarrying; and, as operations have gone forward, the face of the mountain has been drilled, blasted, and shoveled away until it has become a spectacular series of towering benches as numerous as there are letters in the alphabet.

It is out of the question to paint in words a correct picture of this titanic property and to describe the physical obstacles that have been surmounted, one by one, in dealing with this unique deposit; but it will suffice for our present purpose to say that each and every colossal difficulty has been mastered by unfailing resourcefulness and by a continual effort on the part of the management to utilize the newest and best mechanical aids that could be obtained to expedite the work and to lower the cost of production.

Many of our readers may be unaware of the fact that the mountainous deposit of copper now worked in Bingham Canyon by the Utah Copper Company went begging for years because of its isolation, the local deficiency of water, and the low-grade character of the ore; and what has been accomplished in transforming the economic significance of the property has been brought to pass within the comparatively brief span of 26 years. What the mine is today is due directly to engineering skill and to splendid management.

BRIAND URGES A UNION OF EUROPE

FOR many reasons, we of the Western Hemisphere have ample warrant for interest in Premier BRIAND's advocacy of a United States of Europe. A step in this direction was taken at Geneva on September 9, when the representatives of 27 nations were the guests of that astute Frenchman. Whether that luncheon was effective in laying the cornerstone of such a union of interests only time will tell.

To quote from the *New York Times:* "And so, between a pear and some cheese, we laid the little cornerstone of a European federation; discreetly, between a pear and some cheese—which does not, you know, diminish at all the importance of the event." Thus spoke Premier ARISTIDE BRIAND after the luncheon; and some of us wonder whether or not the cornerstone were laid or buried.

It is unquestionably true that the nations of Europe can win much through coöperation and through a recognition that their common welfare has much to gain from reciprocal efforts for better understanding and material rewards; but how far can these efforts become mutual and for the general good of all the nations potentially so associated? The person that points to what has been achieved in the upbuilding of the United States of America must bear in mind the outstanding fact that we have grown to be what we are in the main because we have adhered fairly closely to national impulses and to certain social and civic principles introduced by the pioneers of our colonial days. This heritage has had a great deal to do with the amalgamation of the confederated states and often has been potent in bringing about a pacific mood in one or the other of the states when momentarily antagonistic to the stand of the others. Even so, this heritage was not strong enough to prevent a long and disastrous period of civil war.

How, we ask, can Premier BRIAND hope to bring about a kindred union in Europe by any organization of fully matured nations, each of which is vigorously nationalistic, and each of which has reached its present eminence by following distinctive lines of progress? Centuries of independence in thought in social life, and in economic evolution—not to mention in many cases the speaking of dissimilar languages—would seem to make a European union comparable with that of the United States of America next to impossible. National pride would inevitably interfere with any surrender of individual identity.

The promotion of peace, the fostering of cordial relations in international intercourse are ends to be helped and encouraged in every practicable way; but is Premier BRIAND's scheme practicable? We don't believe so unless human nature and pride of country can be profoundly altered or modified.

SUBWAY SPOILS INCREASE SIZE OF MANHATTAN

THE mechanical moles that have been engaged for many months in tunneling and trenching for the new subway system of the Borough of Manhattan of the City of Greater New York have been casting off spoils that have added 94 acres to this area of the Metropolis, and thus created land along the western waterfront valued at substantially $24,000,000.

During previous work in connection with the city's underground transportation system, the contractors have often been confronted with a serious and costly problem in the disposal of the excavated rock and earth; and in numerous instances these by-products of their labors have been carted to the most convenient docks and there loaded upon barges to be towed to points miles away for final disposition. Naturally, the taxpayer had to foot the bill sooner or later.

In the present program of subway extension, both the contractors and the municipal authorities have collaborated in reducing the expense of spoils disposal; and of the total acreage formed by fills with these wasted materials quite 75 acres have been created along the Hudson waterfront where the natural shore line is very irregular. Besides effecting a radical improvement in the shore line, the by-products of the air-driven rock drill and the power shovel have provided an expansive area that will eventually be turned into a beautiful park and playground. In short, the taxpayer will obtain a very substantial benefit without being called upon to pay for it at a rate that would in other circumstances levy heavily upon his purse. We have in this instance a fine example of what can be accomplished in the direction of economy and lasting gain when city officials, engineers, and contractors join hands for the common good.

SOMETHING TRULY COLOSSAL

THE greatest of America's irrigating projects, the largest of her dams, and the biggest of her flood-control schemes dwindle into relative littleness beside a plan now nearing maturity that has been conceived by three French engineers after something like four years of surveying and studying. These audacious technicists propose nothing less than to dam the Mediterranean at two points so as to transform it ultimately into a stupendous fresh-water lake, and then to draw from this body a flood to irrigate and to make fruitful

far-flung expanses of the Desert of Sahara.

As we learned when we studied the physical geography of Europe, the Mediterranean would be filled with fresh water if it were not for the continual influx of salt water from the Atlantic Ocean. Therefore, with the Atlantic shut out and the Black Sea barricaded at the Dardanelles, the rivers of Europe and Africa would gradually overcome the present salinity of the Mediterranean. With this accomplished the waters would become fresh and capable of promoting vegetal life when pumped into canals dug hither and thither in the present arid wastes of the great African desert. Incidentally, this removal of water from the Mediterranean would eventually lower the level of the land-locked sea about 500 feet and add, in consequence, approximately 430,000 square miles to the present areas of the countries now bordering upon the Mediterranean.

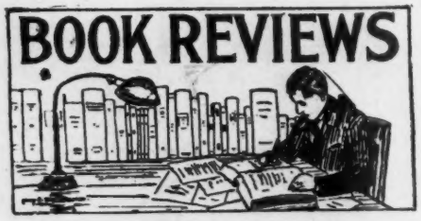
According to the *Associated Press* dispatch that disclosed the status of the project, it is not unlikely that considerable opposition may be aroused when the final details are made public a few years hence. As the news item expresses it: "Though the engineers admit that they do not expect the governments of Europe to take kindly to their scheme, they seem to be enjoying themselves." The creative mind finds satisfaction in its work even when the outcome of its labors is denied popular approval.

IRON ALLOYS TO UNDERGO INTENSIVE RESEARCH

SIR THOMAS HOLLAND, speaking recently at Johannesburg before the British Association for the Advancement of Science, dwelt upon the world's increasing use of metals; and, to add point to his general statement of that fact, he said: "In the year 1870, the United States produced 69,000 tons of steel; in 1880, 1,250,000 tons; in 1890, 4,250,000 tons; in 1900, 10,000,000 tons; and in 1928, 45,000,000 tons."

In passing, let it be said that steel is fundamentally an alloyed form of iron—the principal change in the metal resting basically upon its carbon content. Of the foregoing amazing tonnage of steel produced in the United States during 1928, a notably large share consisted of special or alloy steels developed to meet particular requirements—the alloys used imparting distinctive characteristics that made the steels useful for certain services. Such being the case, our readers will find much to interest them in the formation of an iron alloys committee of the Engineering Foundation. The committee will conduct researches that are believed to be of vital import to the progress of America's iron and steel industry; and the work, which will probably cover a period five years in its initial stages, will entail an outlay of something like $150,000. The iron and steel industry of the United States has attained a notable position in the production of alloy irons and alloy steels; and the object of the researches is to enable the industry to hold its own in competition with the rest of the world.

The committee of technical experts, so it is announced, will not attempt to discover or devise commercial alloys—that will be left to the laboratories in the industry; but an effort will be made to ascertain those underlying facts which may be useful to the industrial metallurgical laboratories. The importance of this undertaking is not likely to be overestimated: it has to do with a department of our industrial life that touches each and every one of us in various ways and in differing degrees—all of them more or less indispensable.



YEARBOOK OF AGRICULTURE 1928. An illustrated volume of 1,145 pages, issued by the United States Department of Agriculture and published by the Government Printing Office, Washington, D. C. Price, $1.50.

THIS annual contains some hundreds of pages of tabulated data dealing with a wide range of agricultural commodities—the figures embracing in numerous instances production over periods of a good many decades. These tables are authoritative and of great value to any student of our agricultural life and the trend of that vital industry. Probably to most persons the other hundreds of pages dealing with what is new in agriculture will prove more informative and more interesting. One has merely to glance over the titles of the different sections of this part of the yearbook to realize something of the extremely diversified nature of the nation's agricultural problem. This book should be on the shelves of all that wish to know what modern agriculture has to offer in the way of a means of livelihood, a source of substantial returns, and a field of essential human endeavor.

ENGLISH AND SCIENCE, by Philip B. McDonald, College of Engineering, New York University. A work of 192 pages, published by D. Van Nostrand Company, Inc., New York City. Price, $2.00.

NO one can speak or write well on any technical subject unless he first have a clear understanding of his topic matter. Next, he must think of his hearer's or reader's point of view and endeavor to address him sympathetically. In short, he must make his speech or written word so lucid that there can be but one way to interpret it. Professor McDonald has striven to emphasize these points. He makes the need of clarity evident, and he goes to some pains to illustrate how a subject should be handled. From our standpoint he offers the student an array of tools, but after all success will depend upon inherent aptitude and much practice. Everybody is not endowed with imagination; and without a measure of it a writer or speaker must fail to be effective because he cannot grasp the other fellow's needs and how best to reach his understanding.

ECONOMICS OF HIGHWAY BRIDGE TYPES, by C. B. McCullough. An illustrated work of 246 pages, published by Gillette Publishing Company, Chicago, Ill. Price, $5.00.

THIS book has been prepared to meet, as the author sees it, an urgent need in the field of highway engineering—that is to say, a concise discussion of the fundamentals of economic analysis and type selection for ordinary highway bridge structures. The aim is to be of service both to the practising highway engineer and to the under-graduate student in highway and civil engineering. Recognizing as we must how numerous are the nation's highway bridges and how varied are their types, it should be apparent that this particular book fills a special niche in the library of an engineer whose task either is or may be that of rearing or designing structures of this nature.

INTRODUCTION TO COLLEGE PHYSICS, by Clinton Maury Kilby, Ph.D. An illustrated book of 349 pages, published by D. Van Nostrand Company, Inc., New York City. Price, $3.00.

BOOKS on physics are plentiful, and it may occur to some to query why should another be prepared dealing with a field that has been already comprehensively covered. The answer is given us in the first paragraph of the preface of this new work. Let us quote: "This textbook of physics is intended to be a brief course in the elements of physics and therefore to supply the need of many schools and colleges offering brief courses. As the usual textbook of physics, consisting of six or seven hundred pages, is too extensive to be completed in one year when the course carries only two or three hours of credit, colleges offering such brief courses have been compelled to use high school texts or make many omissions. Accordingly, there seems to be a need for a text that is concise and accurate and written from the college point of view, and it is hoped that this book supplies this need."

AERIAL NAVIGATION AND METEOROLOGY, by Capt. Lewis A. Yancey. An illustrated book of 316 pages, published by The Norman W. Henley Publishing Company, New York City. Price, $4.00.

THE author has striven, and with success, to produce a book from which the man of average education may obtain a good working knowledge of the elements of navigation and meteorology for use in aviation. Most publications on navigation are either far too advanced or else contain historical and personal reminiscences instead of practical guidance. It is believed that the present volume may be instrumental in promoting the comfort, the efficiency, and the safety of those that choose aviation for a career.

Black Horse of the Sea, by Robert D. MacMillen, is the title of a brochure issued by the Merritt-Chapman & Scott Corporation, New York City. In its 39 pages, the book deals with the marine salvage activities of that well-known organization; and the excellent pictures and the descriptive text give a comprehensive idea of the corporation's wide field of service.